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ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

OBER 30, 1947

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ORING BRIDGES
AND BARGES

EDING WORK
PENN-LINCOLN
PARKWAY

CING CONCRETE
HIGH ALTITUDE

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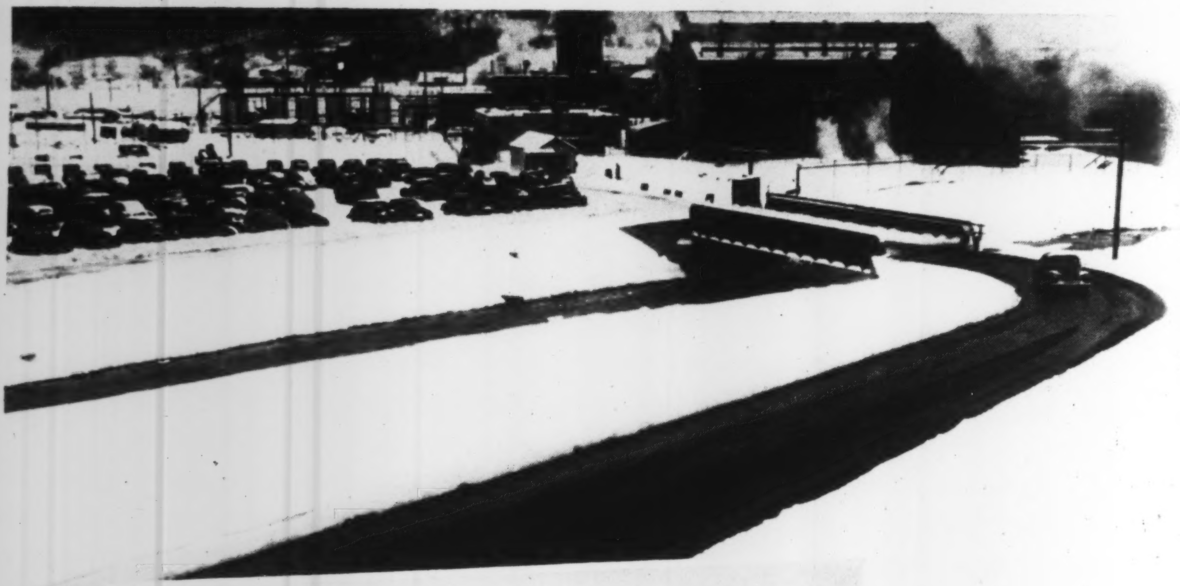

Here's a "PROGRESS REPORT" on a Snow Melting System with BYERS Wrought Iron Pipe

Many engineers, when they hear about a snow melting system, ask "Does it *really* work?" The picture provides a convincing answer.

The view shows a portion of a 600-foot driveway leading from the plant of American Cyanamid Company, Bridgeville, Pa., to the main highway. Two lengths of Byers Wrought Iron pipe were installed under each wheel track, welded into headers at each end, then covered with concrete paving. Water, with anti-freeze solution added, is heated to 165° F. by a steam-fed converter, and circulated through the pipes by pumps.

A 13-inch snow last winter gave the installation its most severe test to date. As can be seen, the system kept the roadway clear of snow and ice, and eliminated the car stalling and traffic delays that would otherwise have occurred at shift changes.

The corrosion resistance of wrought iron, important in all installations, was vital here. The engineers wanted to avoid the use of a gravel foundation. Since the soil in certain areas was acid, a corrosion-resisting pipe material was the only practical solution.

The reason for wrought iron's excellent service qualities is found in the unique structure and composition of the material. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and "detour" corrosive attack. The fibers also help to anchor the initial protective scale, which shields the underlying metal.

If you would like added details on snow melting systems ask for Case Study No. 4.

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A 13-inch snow fall was easily handled by the installation. It is designed to handle 1-inch of snow, or .1-inch of ice, per hour.

This construction view shows twin lines of Byers Wrought Iron pipe laid in left hand lane; concrete has been poured in other lane.

CORROSION COSTS YOU MORE THAN WROUGHT

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation

Volume 139 • Number 18

OCTOBER 30, 1947

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COMING NEXT WEEK

"Toward Lower-Cost Building" is the theme of a special section featuring articles on economical use of steel and concrete and cost-saving construction practices. Included is a report on the status of the prefabricated factory industry and another on experiences with large-size panel construction.

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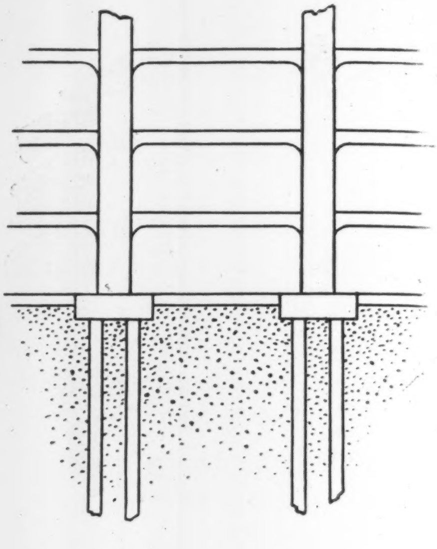
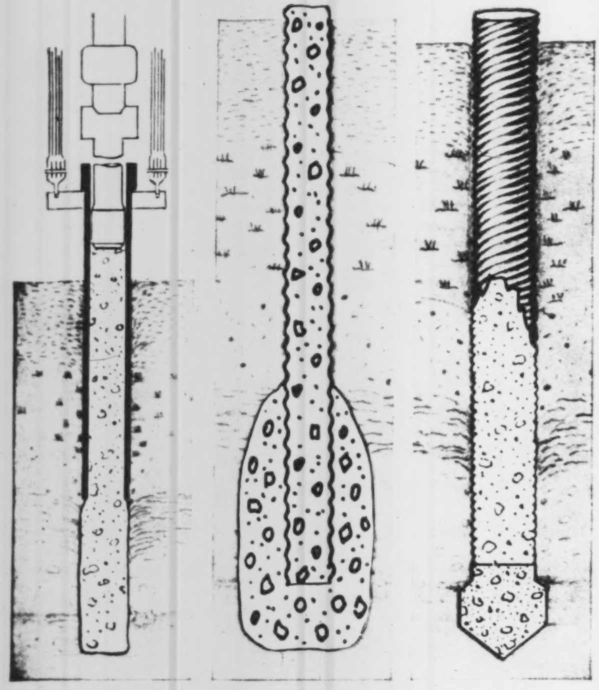
FOR GREATER STRENGTH AND SAFETY

ADVANCED ENGINEERING UTILIZES

CYLINDRICAL COLUMNS

Western uses cylindrical piles





Left: Compressed Concrete Pile—A cylindrical pile of great carrying strength.
Center: WESTERN type Pedestal Pile — Enlarged base affords unusual load capacity.
Right: Button Bottom Pile—Greater diameter base increases bearing value.

LIKE A COLUMN, a foundation pile transfers its load to the base on which it rests. The larger the base, the greater the carrying capacity. Thus, a truncated cone will stand up on its wide base on soil of a given bearing value but will settle if inverted.

Compressed Concrete Piles have bearing capacities up to 80 tons. In cases where the bearing value of the soil is such that the diameter of the shaft does not provide sufficient carrying capacity, WESTERN enlarges the base by forming a pedestal. Another WESTERN pile that utilizes the enlarged base is the Button Bottom Pile. WESTERN provides adequate END bearing to carry the load; what is gained by skin friction is an additional safety factor.

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308 W. Washington St., Chicago 6, Ill.

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2 Park Avenue, New York 16, N. Y.

Construction Trends

Bond Sales for Construction Financing 64% Ahead of a Year Ago

New capital from private sources available for construction in the first 42 weeks of 1947 rose to $1,687,142,000 from $1,031,721,000 in the corresponding period of 1946, a gain of 64 percent. The last seven weeks of this period, however, showed a gain of 191 percent over the corresponding 1946 seven-week period.

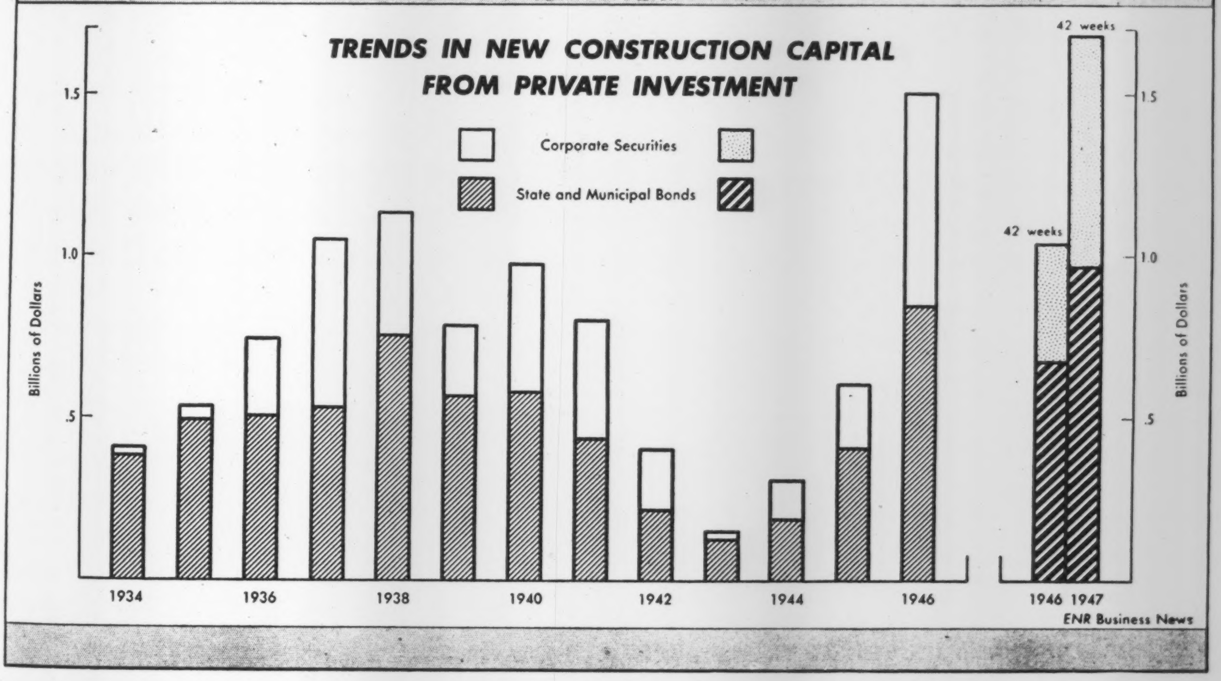
If the rate evident in the past month and a half is maintained throughout the remainder of 1947, total new construction capital from private sources may reach $2,225,000,000. If, on the other hand, the accelerated rate of private investment attained in the first half of October is continued, new private capital for construction may approximate $2,500,000,000.

Of the total private construction capital available in the first 42 weeks of 1947, 57 percent went into state and municipal bonds and the remaining 43 percent into corporate securities. This compares with the ratios of 64 percent and 36 percent, respectively, for state and municipal bonds and corporate securities earlier in the year. Apparently, private capital for private construction is accumulating at a faster rate than private capital for public construction.

Of the total state and municipal bonds made available so far this year for public construction, 40 percent has been slated for buildings, or $388,358,000. The remaining 60 percent has been earmarked for waterworks projects, sewerage projects, streets and roads, airports and unclassified construction.

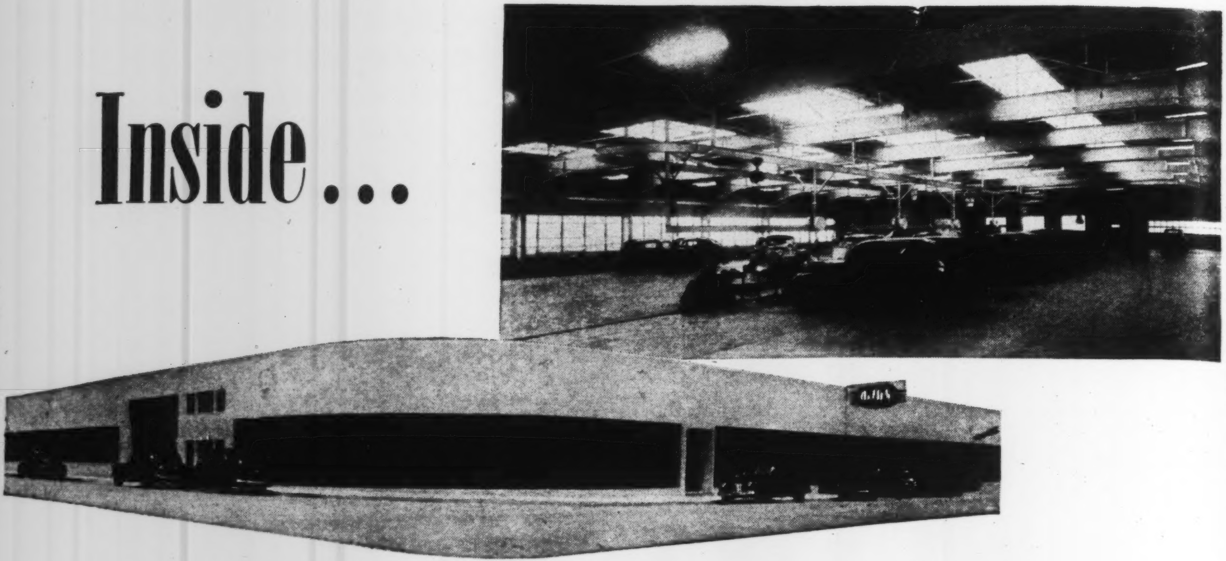
State and municipal bonds totaling $966,838,000 in the 42-week period of 1947 showed a rise of 43 percent over the corresponding 1946 period. At the end of April of this year, the cumulative total was nearly double the 1946 total. Despite the ground lost in recent months as compared with a year ago, private capital for state and municipal bonds may approximate $1,250,000,000 for 1947 at the present rate of financing as compared with $848,141,000 a year ago.

Private capital invested in corporate securities for construction purposes amounted to $720,304,000 for the first 42 weeks of 1947. This was a gain of 102 percent over the $357,347,000 invested in the corresponding period of 1946.



ENR Business News

Inside…



Bird-Kultgen Ford Sales & Service Building, Waco, Texas. Engineer and Architect, H. L. Spicer; Contractor, C. C. Ramsey; Concrete furnished by Waco Ready Mix Concrete Co. and Clark Transit Mix Concrete Co., all of Waco, Texas.

…and out

"…well pleased with Duraplastic in every respect," reports contractor

And he goes on to say that he particularly liked the ease with which Duraplastic concrete was placed and finished.

Characteristically, Atlas Duraplastic air-entraining portland cement required less water. It provided better workability and placeability. It made a more plastic, more uniform and more cohesive mix. Bleeding and segregation were reduced. There were no "honeycomb" spots or streaks.

These advantages are typical of Duraplastic's performance—whether for paving, structural or mass concrete. Its use requires no unusual changes in methods—just the same good workmanship and careful supervision regularly employed.

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ENR-D-56

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AIR-ENTRAINING PORTLAND CEMENT

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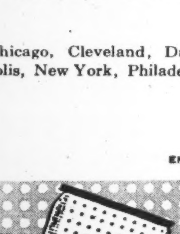


"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—ABC Network*

News of the Week

ENGINEERING NEWS-RECORD • OCTOBER 30, 1947 • VOLUME 139 • NUMBER 18

See 12 billion dollar-volume for construction in 1947

Heavy construction showing increase, but housing and small structures account for biggest part of forecasted total—Demand for building continues high

Construction dollar-volume for 1947 will approach an all-time record, it became apparent last week, as a number of reliable indicators pointed to a $12,000,000,000 business for the year.

Engineering News-Record's statistical checks on contracts awarded for heavy engineering construction forecast $5,500,000,000; and the Bureau of Labor Statistics of the Department of Commerce estimated that all new construction put in place would top $12,000,000,000.

If the final total should reach that figure, it would make 1947 the second greatest construction year in history from a dollar-volume standpoint, second only to 1942, when the total was $12,821,000,000. Incidentally, it would almost exactly fit this journal's prediction for the industry made nearly a year ago (*ENR* Jan. 2, vol. p. 1).

Although heavy engineering construction now shows a rise that will approximate a 5 percent gain over 1946, the major part of the total seems to be accounted for in smaller structures—notably housing and small business buildings.

Housing work itself is approaching boom proportions, despite rising prices, and is now expected to top 800,000 units by the end of the year (*ENR* Oct. 23, vol. p. 560).

Early slump discounted

The high volume this year will be scored despite a mid-season slowdown in the heavy construction category. By the end of the first quarter of the year—the *Engineering News-Record* "average week to date" indicator fell to a low of $91,000,000. But, by the end of October, this marker rose to $107,000,000, bolstered by heavy commitments during September and October.

Industry observers pointed out that while costs remain high increased job productivity appears to be offsetting current price and wage rises. They said the upswing is due to general acceptance of current conditions and decision to go ahead with construction.

ENR's statisticians added that the need for construction is today as great as it was at the end of the war, and that in spite of a near-boom, only 1,500,000 houses have been completed—a figure not considered adequate to cope with the normal increase in the number of families in the United States. All of this forecasts continued high demand for housing.

Although proceeding cautiously on the basis of current figures, the statistical staff of this journal last week ventured a preliminary estimate for 1948 that showed a possible increase of from 5 to 25 percent in dollar volume, depending on business conditions.

With both personal and industrial income continuing at high levels, it was indicated that some increase is inevitable for the coming year.

The continuing inventory of proposed engineering construction maintained by *Engineering News-Record*, shows a dollar-volume of individual projects that totals $40,456,032,000, and since some of these projects were entered in terms of 1940 construction dollars, the backlog can be taken to exceed $45,000,000,000 in 1947 terms.

Canadian home building costs continue to rise

House building costs in Canada are still climbing, and it takes longer to complete housing units according to a statement issued at Ottawa by Central Mortgage and Housing Corporation—Canada's publicly-owned housing company. House building activity in the first half of 1947 was not up to the record set in the corresponding half of 1946, the organization said.

The only bright spot in the picture is that production of ten selected building materials during the first half of the current year showed a decided increase over that in 1946.

Speaking in Vancouver, B. C., recently Reconstruction Minister C. D. Howe announced that Canadian municipalities had been asked to cooperate with the federal government in providing veterans with 12,000 low cost houses in 1948. Noting the main gap in Canada's housing program to date had been in the low rental field, Mr. Howe explained that plans had been prepared for a new type of housing unit which would rent for from $27 to $37 per month. The houses would be built and financed by the dominion government in municipalities which agree to provide land and services.

Low bid $11.1 million on new Tacoma bridge

With tentative acceptance of low bids totaling $11,196,584 for reconstruction of the Tacoma Narrows suspension bridge, the Washington State Toll Bridge Authority has set Dec. 2 as the date for bids on a $14,000,000 issue of revenue bonds to finance the project.

The bond bids must be received and accepted before the authority can make a contract award on actual construction of the bridge.

The Bethlehem Pacific Coast Steel Corp. of San Francisco, Calif., is low bidder at $8,263,904 for the bridge itself, with John A. Roebling & Sons Co. low at $2,932,681 for cables, hanger ropes and steel parts.

The bids ran 34 percent higher than estimates, Gov. Mon C. Wallgren said.

Meanwhile, plans for construction of another toll bridge by private capital in the Puget Sound area were opposed by the authority. Earlier, the Puget Sound Navigation Co., ferry operator, had announced it proposed to build an $840,000 structure across Agate Pass from the north end of Bainbridge Island to the Kitsap Peninsula. Such a bridge would enable the company to rearrange its routes for maximum operating economy.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Public Construction—A contract for building $2,875,000 worth of facilities for the new Eastern State Hospital near *Williamsburg, Va.,* will be let to J. Kennon Perrin & Co. of Richmond . . . Veterans Administration is accepting bids for a 100-bed addition and other alterations at the tuberculosis hospital in *Livermore, Calif.* . . . Contract will be let Nov. 7 for the first earth embankment of the $12,000,000 Lavon Reservoir on the East Fork of the Trinity River 3 miles from *Wylie, Tex.* . . . Construction work on the $2,000,000 VA hospital in *Erie, Pa.,* is expected to start early next year . . . The U. S. Public Health Service has approved the $72,000,000 construction program for community hospitals in *Texas* . . . Plans are under way for ten buildings at the new Villa Marie College, *Erie, Pa.,* to cost $1,000,000.

Industrial Construction — Niagara Hudson Power System in *western New York* will spend $100,000,000 during 1947-51 for construction of increased generating, transmission and distribution facilities. . . . A plant for the manufacture of phthalic anhydride is being built by the Barrett division of the Allied Chemical & Dye Corp. at *Ironton, Ohio* . . . National Pressure Cooker Co., *Eau Claire, Wis.,* has begun a $3,000,000 expansion program . . . Construction has started on about 74 miles of 20-in. crude oil pipe line between *La Plata, Mo.,* and *Fort Madison, Iowa.* O. C. Whitaker Construction Co. of Fort Worth, Tex., has the contract for about $3,150,000.

Highways—The *Pennsylvania* department of highways has programmed 20,400 miles on the state system for complete winter service, chiefly for snow removal . . . *North Carolina* State Highway Employees Association has adopted a program calling for salary increases, annual leave and retirement. A plan for a *Detroit, Mich.-Chicago, Ill.,* expressway via the general route of U. S. Highway 12— 275 miles long— is being considered.

Sewers and Water Supply—Connecticut voters will pass on an appropriation of $3,300,000 for construction of reservoirs at Cedar Mountain and Wickham Hill, Conn., to serve *Hartford, Bloomfield, Windsor, Wethersfield, East Hartford, Newington* and *Rocky Hill.* To be voted on also is $4,000,000 for sewer work in the same places. . . . Work on a new filter plant at *Richmond, Va.,* to cost about $1,500,000, is scheduled to begin next month. . . . A $4,000,000 bond issue for drainage work has been approved at *Beaumont, Tex.* . . . The *Honolulu, T. H.,* board of water supply is putting into use a new 2,000,000 gal. reservoir just completed at a cost of $339,518 . . . A project report on a proposed $6,000,000 joint sewage works for 13 municipalities and the industries of the *Overpeck Valley* has been submitted to the Bergen County-Hackensack River Sanitary Sewer District Authority of New Jersey by Bogert-Childs Associates.

Housing—Work on five residential projects providing homes for 1,284 families in *Phoenix, Mesa* and *Yuma, Ariz.,* and representing an investment of $5,400,000, has been started by the Stewart Construction Co. of Phoenix. . . . Plans for a $15,000,000 housing project in *New Orleans, La.,* which would include 500 homes and 1,060 apartment units, have been announced by Robert F. Morrow, city housing director. . . . George A. Poag & Associates, *Fort Wayne, Ind.,* have announced plans for construction of 144 veterans preference housing units.

Ontario Hydro builds huge new unit

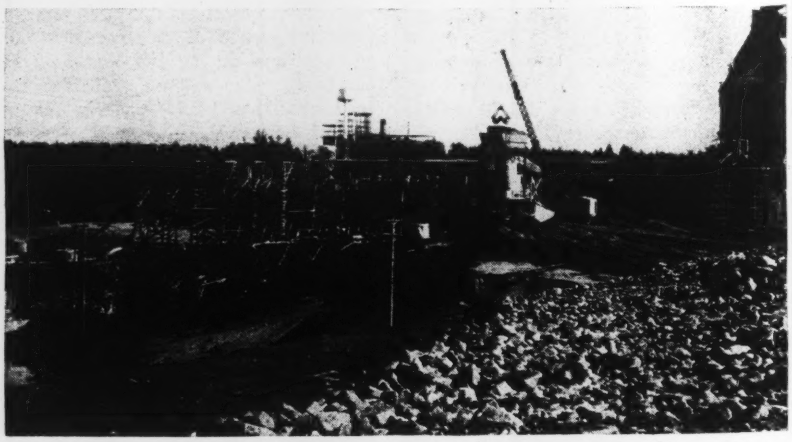
A 55,000 hp. hydro-electric installation to supply power for paper-pulp manufacture is now under construction by the Hydro Electric Power Commission of Ontario on the Aquasabon River near the town of Schreiber, on the north shore of Lake Superior.

The greater part of the power to be developed will be supplied to new $23,000,000 pulp mills of the Long Lac Pulp and Paper Co., Ltd. now under construction on a site adjacent to the dam. Remaining power will further augment the commission's Thunder Bay System by means of a 110,000-volt steel tower transmission line, 70 miles in length. Total cost of the project is estimated at $10,000,000, with $1,500,000 being the estimated cost of the transmission line.

The dam will provide a reservoir area of 3,000 acres, water entering the reservoir at an average flow of slightly less than 1,000 cfs. The intake structure, tunnels, and generating station are located west of the dam at a point on the reservoir where the 297-ft. head, between the reservoir and Lake Superior, may be obtained with a minimum of conduit and penstock length. The terrain of the whole area is extremely rocky as may be seen in the accompanying photograph.

The water will enter the intake structure at the edge of the reservoir through six ports controlled by a steel-plate vertical cylinder gate and will drop vertically 270 ft. through a concrete-lined shaft bored through rock to a horizontal tunnel. This tunnel will convey the water over a distance of 3,400 ft to a steel penstock, 15 ft. in diameter, through which it will travel for another 100 ft. feeding the two generating units which will be installed in the powerhouse.

Actual work on the project began in the early part of 1946 and it will be completed by the end of 1948.



***Concrete flows** into forms for first section of Aquasabon Dam, a paper-mill power development on the north shore of Lake Superior, in Canada.*

States begin planning future road jobs as costs, shortages slow current work

Emphasis placed on over-all planning of highway networks—High costs, labor and material lack reported

While much highway work is being postponed on account of current high costs, many states last week were preparing for future road construction.

Developments included:

The Florida State Improvement Commission empowered Elgin Bayliss, chairman of the State Road Commission, to employ consulting engineers to prepare a traffic survey of Duval County showing the financial soundness of the proposed $36,000,000 superhighway system at Jacksonville (*ENR* Oct. 23, vol. p. 557).

Nebraska proposed a survey of the state's highway needs by the Automotive Safety Foundation to determine the best statewide highway program how long it should take to complete such a network, and how much it probably will cost.

In Illinois the State Highway Division said it will survey the principal highways in St. Clair and Madison counties, following a request by the Metropolitan Plan Association of St. Louis, Mo., which is working to improve approaches to that city.

The Public Administration Service of Chicago completed a survey of Kentucky's road program, and warned that counties are taking their road problems to the state's rural road division with increasing frequency. If this continues, the report indicated, the state might find itself spending a "disproportionately large" share of the road fund revenues on roads that are least important from the standpoint of general use.

Shortages and high costs

Plans for express highways in Massachusetts seem to have bogged down, despite $30,000,000 of available federal aid. As of last July 1, only 33 projects, representing 46 miles of road and a cost of $5,500,000 to the federal government and $4,900,000 to the state, had actually been put under construction, and in the last three months only $200,000 in new contracts have been awarded—for resurfacing parts of the old Worcester Turnpike in Wellesley.

Delay in building multi-million dollar road projects in the Bay State, according to public works officials, has been due to shortages of materials, engineers and laborers and particularly because of the lack of bids or high bids.

Connecticut Highway Commissioner G. Albert Hill in an annual report stressed inflated prices and shortages of materials and supplies as detriments to a full schedule of road construction. Despite many difficulties, Mr. Hill said, the highway department completed 106 projects during the fiscal year at a cost of $6,700,000 and started 74 other projects that will cost $15,000,000 when completed. Great progress was made on the construction of the Wilbur Cross Parkway.

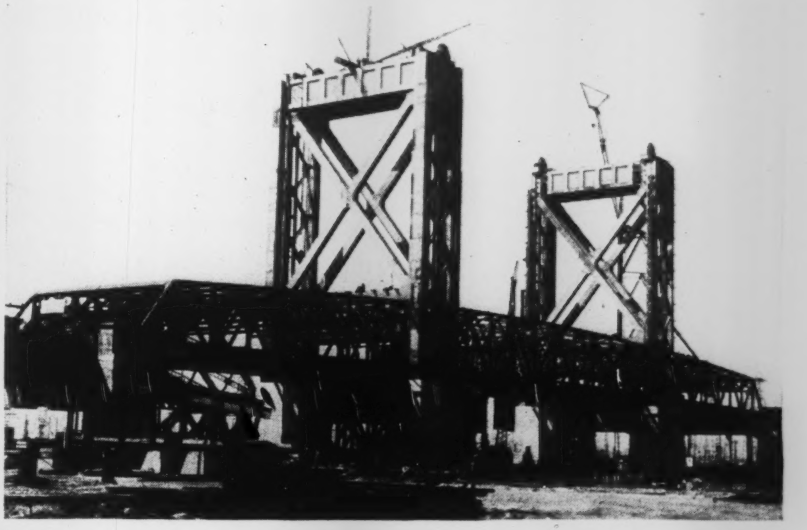
Governor Roy J. Turner of Oklahoma recently visited Pennsylvania to discuss toll road operation with Governor James H. Duff of that state since Oklahoma is planning the construction of a 100-mile turnpike between Tulsa and Oklahoma City. It was reported that the Oklahoma Turnpike Authority must determine whether materials can be obtained to build the proposed 4-lane toll highway before bonds can be issued. Shortage of labor and materials which has affected highway construction in the state has become an important consideration in the preliminary plans for getting the project started.

Plans have been completed by the North Carolina State Highway and Public Works Commission for a new $1,500,000 West Asheville bridge across the French Broad River.

The Mystic Bridge Authority is offering $27,000,000 revenue bonds to construct a high-level toll bridge over the Mystic River from Charlestown to Chelsea, Mass.

A bid of $70,140 for construction of a high-fill approach to the north end of the proposed new bridge over the Mississippi River at Hastings, Minn., was made by S. J. Groves and Sons.

Future tourist travel through heretofore inaccessible areas of southern Utah is a possibility as result of location of a new bridge site on the Colorado River. The site was discovered by survey officials during a pack train expedition through the area—one of the most rugged in western America. Termed one of the finest bridge sites on the Colorado, the location is at the mouth of North wash which cuts into the north rim of Dirty Devil canyon. North entry to the bridge would be from the road between Hite and Blanding, while on the other side the road would connect with one leading to Blanding, Monticello and Mesa Verde.



Terminal Island Bridge Nears Completion —*This lift bridge being built as part of the Terminal Island Access Freeway, connecting the island with Los Angeles and Long Beach, Calif., is expected to be completed and in service early next year. Although the span length (240 ft.) is not of record size, it is believed that the lift (from 50 to 175 ft. above water) is the highest in this country. Surface area of the lift span (two 35-ft. roadways) is also believed to set a record. The bridge was built under Navy supervision by the United Concrete Pipe Co., general contractor, and the American Bridge Co., subcontractor for steel erection.*

HIGHLIGHTS OF MUNICIPAL DEVELOPMENTS

Drought in East poses municipal water supply problem—Many highway projects up for consideration—Omaha studies city manager plan—Other municipal affairs

A virtual drought of more than a month's duration in the eastern part of the United States last week began to pose serious supply problems to municipalities.

At Altoona, Pa., the several reservoirs feeding the city's water system were said to be reaching "alarmingly" low levels and the city looked to the necessity of imposing use restrictions if relief is not forthcoming.

George A. Busch, Jr., director of the Water Bureau, said that Lake Altoona—largest of the city's reservoirs—is now at slightly more than half capacity. He said all street flushing has been discontinued and stringent measures are to be invoked later.

In New England, a similar problem faced many cities, a quick survey showed. Because of continued lack of rain, rivers and ponds were said to be at their lowest levels in years, and hundreds of wells have dried up. Only 5 in. of rain have fallen in some areas in more than three months. Apparently hardest hit are the towns in Worcester County, and the general shortage of water has had an adverse effect on hydroelectric power production.

Winston-Salem, N. C., which only recently was relieved of a water shortage that had caused city officials to appeal to President Truman for assistance in obtaining supplies, received a report from John D. Watson, Greensboro, consulting engineer, advising against raising of the dam at Salem reservoir unless there is no prospect of an early development of new water supply from the Yadkin River. The dam has already been raised once, and Mr. Watson said that any further increase in the crest height, without a corresponding widening of the base, would be structurally unsound. The cost of such construction would require more than the value of the additional water supply obtained, the engineer added.

In Columbus, Ohio, the Franklin County Planning Commission appointed a special committee to survey the problem of extending the city's water and sewage treatment facilities for use by all county residents.

Many highway plans

Although a good deal of current work is being confined by high costs and material shortages to necessary repair and rehabilitation, most cities continued to plan for future road construction.

The Rhode Island Department of Public Works announced that it would construct a scale model of the proposed express highway in the Providence-Pawtucket area as a means of acquainting the public with the appearance and purpose of the route. The proposed highway, under discussion for more than a year, would slice directly through Providence and Pawtucket in a north to south route, and may eventually be extended northward to the Massachusetts line to provide a high speed artery through the most heavily congested district of the state. Estimated costs are about $52,000,000.

Initial work on the Millcreek Expressway, the first extension of a superhighway built to serve the Lockland Wright plant in Cincinnati, Ohio, during the war, appeared near last week, and the state highway department considered bids received. The $2,000,000 will include construction of a four lane expressway from Paddock Road to Hartwell Avenue, construction of grade crossing elimination structures and other work.

At Rock Island, Ill., the city council unanimously voted to oppose the construction of a proposed interregional superhighway through the city. The action was taken after several aldermen pointed out the disadvantages of routing the road through the city, with resultant loss of taxable property taken for right-of-way.

Fort Wayne, Ind., awaited the results of voting on Nov. 4 on the issuance of bonds to finance an express highway through the city, and Phoenix, Ariz., said it would decide by January 1 on whether to construct an expressway.

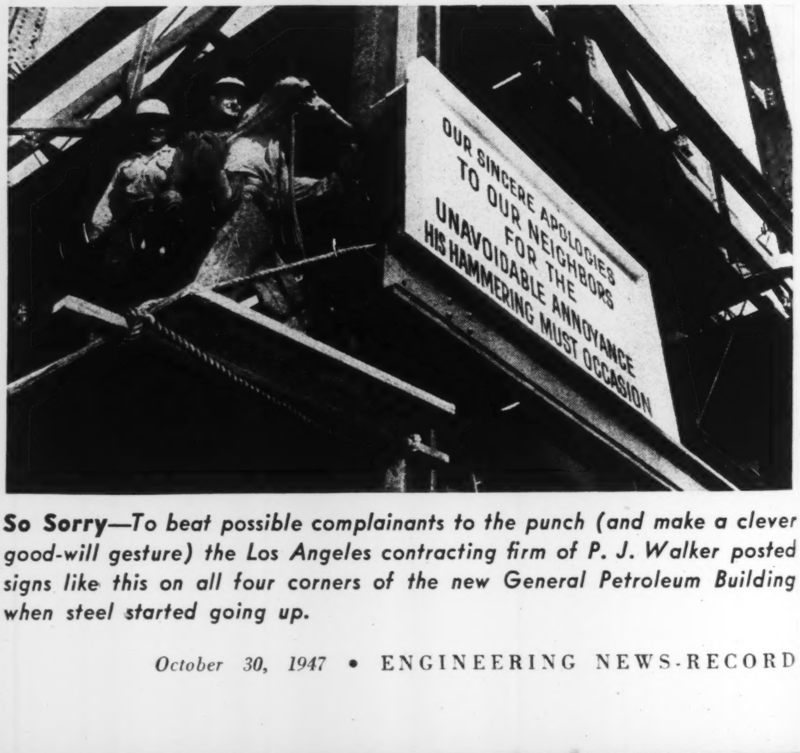
Study manager plan

A recommendation that Omaha, Nebr. study the possibilities of adopting a city-manager form of government has been placed before the city's chief executive.

The recommendation was made by members of five official improvement commissions who contend that such a plan would make for efficient and economical government.

To build parking garages

Plans of Phoenix, Ariz., to construct publicly owned parking facilities in downtown area advanced last week when a San Francisco contractor who submitted a successful bid for the construction of the building, accepted a proposal from the Municipal Planning Commission to erect a 400-car garage. The structure would be erected and operated by Benjamin Swig, San Francisco financier, under a 50 year lease.



So Sorry—*To beat possible complainants to the punch (and make a clever good-will gesture) the Los Angeles contracting firm of P. J. Walker posted signs like this on all four corners of the new General Petroleum Building when steel started going up.*

Authority leases Newark air, sea ports

A long-time dream of unifying air transport facilities in the metropolitan New York area neared reality last week when commissioners of Newark, N. J., approved an agreement that will permit the Port of New York Authority to take over operation of that city's airports.

The authority took over New York City's two major airports—LaGuardia Field and Idlewild—on June 1 of this year, under terms similar to those approved at Newark.

In addition to assuming operation of the Newark airport, the bi-state authority will also assume operation of the Port of Newark. The combined programs call for investment by the authority of $55.000,000 for the airport and $15,000,000 for the port.

Announcement of the agreement with Newark was followed almost immediately by another from the Air Transport Association that major airlines serving the metropolitan area will henceforth divide their flights between LaGuardia Field and Newark Airport to relieve the overload at the New York City base.

Will pay Newark rent

Under terms of the agreement with Newark, the Port Authority will guarantee the city $100.000 a year as rental, or 75 percent of the net profits from its operation. In return for the lease, the authority will expand the present airport by acquisition of 800 additional acres, will build a 76-acre terminal area, extend runways and make other improvements. Work at the Port of Newark would include establishment of new roads, rehabilitation of existing buildings and construction of transit sheds, bulkheads and rail and road facilities.

The proposal to the city of Newark is the result of a request by city commissioners in 1945 for a survey by the authority of possibilities of the port. A report was submitted to the city late in July, 1946 (*ENR*, Aug. 8, 1946. vol.p. 149) and the matter has been under consideration by the city commission ever since.

New Jersey fights dock proposal

Meanwhile, the Port Authority in its expanding activities in the transportation field received the official support of the State of New Jersey as it opposed another governmental group seeking to take over New York City's dock facilities.

About a week ago (*ENR*, Oct. 23, vol. p. 563) the World Trade Corporation —a New York State body—proposed a $250,000,000 program for a complete rehabilitation of the city's waterfront facilities. Under the plan, the corporation would lease city owned piers and other facilities for not less than 40 years and would spend more than $89,000,000 on construction of new piers alone.

The Port of New York Authority immediately filed objections to this proposal, and then was asked by Mayor William O'Dwyer of New York City to submit its own proposal for waterfront rehabilitation.

Last week, Governor Alfred E. Driscoll of New Jersey, discussing the World Trade Corporation's proposal at a press conference, said that he believed the World Trade Corporation proposal probably violates the letter of the interstate agreement creating the Port of New York Authority and that he would oppose its plan.

Make engineering survey of Delaware River ports

Improvement and development of Delaware River port facilities from Trenton, N. J., to Delaware Bay is being undertaken by the Delaware River Joint Commission which on Oct. 22 retained the Knappen Engineering Co. of New York to survey port facilities of Trenton and Camden, N. J., Philadelphia, Pa., and Wilmington, Del.

This action was taken under authority granted to the commission by Gov. James H. Duff of Pennsylvania and the New Jersey Legislature early this year. The commission has appointed Maj. Gen. Harry B. Vaughan, former U. S. district engineer in Philadelphia, as port survey engineer. The Knappen company is to submit its recommendations relating to the various ports along with a plan for developing and increasing port business.

Press Assn. photo

Co-op Housing—*Eleven 4- and 5-story buildings will house about 164 units in a cooperative housing project now under construction at Chicago, Ill. Of concrete-block construction, the buildings will be radiant-heated, and 5-story structures will be provided with elevators. Hollow-steel joists, visible in lower photo, will provide "beamed" ceilings for the apartments. Eric Borg Co., August Oman, and Trusslab Corp., all of Chicago are the contractors.*

ENGINEERING SCHOOL NEWS

Foundation laid for University of Chicago cyclotron—Plenty of jobs for Wisconsin graduates—Many engineering school faculty appointments and changes

Construction workers recently began work on foundations for the new 170-inch cyclotron of the University of Chicago. It will be the most powerful in the world and cost $1,700,000. A total of 700,000 cu.yd. of concrete were poured into a pit 35 ft. deep, the initial step in construction of the first building in the university's $12,000,000 nuclear research program.

Of the 178 May engineering graduates of the University of Wisconsin, including 22 civil engineers, only one is now unemployed. Prof. David J. Mack, head of placement for the engineering college, said that there have been three or four job offers for every graduate.

More humanistic subjects for engineering students in their first four college years and then one to three years' specialized study for scientific degrees has been advocated by William V. Houston, president of Rice Institute of Technology, Houston, Tex.

The University of Michigan School of Public Health is offering an in service training course in garbage and refuse collection and disposal for public works officials.

Three new men have been added to the faculty of civil engineering at the University of Florida. John E. Kiker, Jr., formerly district sanitary engineer with the New York State Department of Health becomes associate professor of sanitary engineering. Mr. Kiker did his graduate work in sanitary engineering at New York University and has been with the New York department since 1936, except for a period as an officer in the Sanitary Corps and a short time as director of public health engineering in Yonkers, N. Y. His experience has also included work as a sanitary engineer with the International Water Co. and Massachusetts State Department of Health. D. Allen Firmage of the U. S. Engineer Board has been appointed assistant professor in structural engineering. He did his bachelor's work at the University of Utah and his master's work at M.I.T. He has been with the Engineer Board Research and Development Laboratories since 1942. Richard K. Steele becomes instructor in structural engineering. He is a graduate of the University of Pittsburgh and has been with the Curtiss-Wright Corp. of Columbus, Ohio, where he has been senior research engineer on the guided missile program.

T. DeWitt Carr, a captain in the Navy until his recent voluntary retirement, has become dean of the school of engineering and architecture at the University of Kansas, succeeding J. O. Jones, professor of hydraulics, who has been acting dean since 1943, and who now returns to full-time teaching in the school.

Hans Albert Einstein, well-known hydraulics engineer and son of Albert Einstein, the noted theoretical physicist, has been appointed acting associate professor of engineering on the Berkeley campus of the University of California. An authority on the hydraulics of rivers and sediment transportation, Dr. Einstein, 43, left a position with the U. S. Department of Agriculture Soil Conservation Service as research hydraulic engineer to join the UC staff. He was born in Berne, Switzerland, received his doctorate at the Swiss Federal Institute of Technology, Zurich, and came to the United States in 1938.

William A. Oliver, associate professor of civil engineering, and Ralph B. Peck, research assistant professor of soil mechanics in the civil engineering department, University of Illinois, have been named full professors of civil engineering. Mr. Oliver has been giving courses in structural analysis, construction materials, structural design, and estimates and costs. Among Professor Peck's courses have been structural design in wood and steel, airport design, and special research work in soil mechanics and foundations.

Theodore O. Reyhner, associate professor of civil engineering at the University of North Dakota, has resigned to become associate professor at the University of Oregon where he will teach structural architecture.

George E. Lyon, instructor in civil engineering at the University of Minnesota, has resigned to accept an assistant professorship in civil engineering at Cornell University. He has been teaching in the surveying division but at Cornell will return to the field of fluid mechanics.

Prospective bidders see Fort Randall site

Representatives of 45 contracting firms attended a meeting at Pickstown, S. D., Oct. 15 to get first-hand information on the construction program for Fort Randall Dam and to inspect the site.

Called by Col. Louis W. Prentiss, district engineer at Omaha, to acquaint prospective bidders with plans for building the 28,000,000-cu.yd. rolled earthfill dam across the Missouri River, the meeting was arranged to facilitate study of a 10,000,000-cu.yd. excavation and embankment contract which will be advertised about Nov. 3.

Construction on the initial earthwork contract is to begin as early as weather permits in 1948 and is to be completed by the end of May, 1949. Of the 10,000,000, cu.yd. to be excavated about 5,500,000 yd. will be placed in embankment. The main earthwork and outlet works contruction will be advertised late this year, and contracts will be awarded during the first part of 1949. Completion of the project, including spillway and powerhouse, is scheduled for 1953.

Water bond financing for N.Y. sewage improvement

Declaring that "it is an obligation of the Board of Water Supply not only to bring pure water to New York City consumers, but also to see that it is free from sewage pollution before it goes back into the public waters," Mayor William O'Dwyer disclosed last week that he was studying the legality of a plan to finance construction of six sewage disposal plants with water supply bonds, as part of the program.

The mayor's novel proposal to raise $79,000,000 takes into account the fact that these bonds would be exempt from the city's constitutional debt limit. It also suggests an alternative to the sewer-service charge method of financing, which was proposed by the city's planning commission a few weeks ago.

Some observers point out that the sewer service scheme—in which the sewage disposal costs would be levied as a separate charge to consumers—is not popular politically. If water-bond financing is used, the charges would appear simply as an increase of water rates rather than as a new and separate tax.

F. H. Zurmuhlen to head N. Y. city public works

Frederick H. Zurmuhlen, formerly chief engineer for the George F. Driscoll Company of New York City, last week was appointed city commissioner of public works.

An engineer of long experience in the construction field, Mr. Zurmuhlen is a native of New York City and received engineering degrees from Manhattan College. From 1933 to 1935 he served as assistant state engineer for the Public Works Administration; from 1935 to 1937 was chief engineer for the Reconstruction Finance Corporation, and from 1937 to 1941 was consulting engineer for the New York World's Fair.

He was later chief engineer for the George F. Driscoll Company and the Walsh Construction Company (1941-1943) supervising engineering work on the $86,000,000 Army base at Trinidad. Since 1943, he has been in charge for the Driscoll organization on planning and supervising the Brownsville housing project and a number of important buildings in South America. He is also a member of the engineering firm of Corry-Zurmuhlen of New York City.

◆

Fight special N. J. taxes for sea erosion work

A taxpayer's suit charging discrimination in favor of seacoast cities was opened in New Jersey Supreme Court last week to test the constitutionality of a state law giving these cities power to levy taxes to finance anti-erosion programs.

Frank D. Holmes, director of the Division of Navigation of the State Department of Conservation told Supreme Court Commissioner W. E. Brown that erosion from Sandy Hook to Cape May is increasing, and will result in severe loss of taxable values, increased tax rates and a deterioration of the land market. Mr. Holmes declared that $3,000,000 must be spent to protect Atlantic City's beaches from erosion.

The taxpayer's suit, instituted against luxury taxes, the proceeds from which have been used in the anti-erosion fight, was brought by Thomas J. Karins, Sr., whose attorneys claim that the enabling act is "class legislation." The cities contend that since erosion is one of the problems peculiar to coastal cities, special legislation for them is justified.

Holmes points out that completion of erosion programs in coastal communities will cost over $15,000,000.

Oregon installs radiant-heated road

To end winter skidding danger on an 8 percent highway grade separation at Klamath Falls, the Oregon Highway Department is now building a section of radiant-heated pavement. This steep grade will be winter-proofed by an adaptation of radiant panel heating making use of nearby natural hot springs as a heat source.

A similar idea was used last winter in Belmont, Mass. (*ENR* Apr. 10, vol. p. 556).

A 10-in. well 250 ft. deep near the highway provides natural hot water, with temperatures up to 220 degrees. A 2-in. main runs from the well to the pavement and parallels it for about 400 ft. In the pavement slab is placed ¾-in. pipe, 18-in. o.c., in 60-ft. panels. Each panel will be connected with the 2-in. hot-water main by valves which will assure an even flow of water through each panel.

The 2-in. main and the series of 60-ft. panels of ¾-in. pipe will comprise a closed circuit. Hot water from the wells will not be allowed to enter this circuit. Instead, the circuit will be filled with ordinary water in which anti-freeze solution will be introduced. This water will be warmed by means of a heat transfer unit comprised of 2-in. pipe extending close to the bottom of the well in order to obtain maximum immersion. Inserted in the closed circuit will be a pump, thermostatically controlled. When air temperature drops to the freezing point, the pump will automatically start, circulating the water through the closed circuit. At the same time, another pump will begin exhausting hot water from the well at a rate sufficient to maintain the maximum temperature in the well. Unless hot water is so exhausted, constant circulation of the cold water through the heat transfer unit will have a tendency to cool off the well.

The pumps will continue to operate until air temperatures rise above the freezing point.

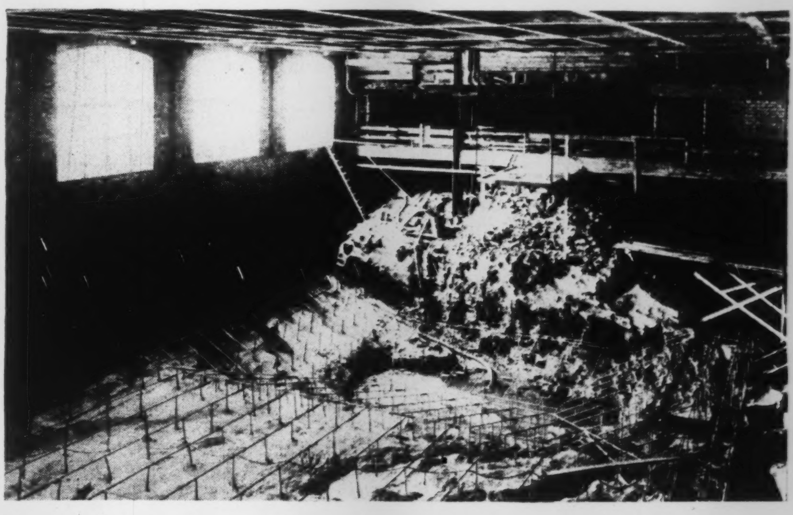
◆

See Indiana road bridges adding to flood hazard

The Indiana Flood Control Commission said in a recent report that about two-thirds of that state's highway and railway bridges were built with openings too small to permit easy flow of flood waters.

Attorney General Cleon H. Foust has been asked by the commission for an opinion on the powers the commission will need to force remodeling of privately-owned railway bridges where critical flood hazard is shown to exist.

The State Highway Commission and the Flood Control Commission will cooperate in studying plans for future highway bridges.



***Pool for Princeton** — Now under construction, a swimming pool in the Herbert Lowell Dillon Gymnasium at Princeton University will be 101 ft., 9 in. long and 54 ft. wide, with a maximum diving depth of 13 ft. To guard against uplift, the pool floor is tied down by a welded grid of 1-in. bars, grouted two ft. into rock. Above a concrete fill (to be poured) the horizontal bars are set for floor slat reinforcement. Aymar Embury III is architect.*

Urge Indiana communities to use state bldg. code

A policy committee representing the Indiana construction industry recently adopted a resolution, urging communities lacking adequate building codes to adopt the Indiana state code and make it applicable to local housing construction.

Charles Bacon, building commissioner for Indianapolis and a member of the committee, said many former servicemen who purchased homes on the perimeter of the city have complained to him about such things as bad plumbing, foundations settling and faulty joist work.

One bad aspect of this situation, Bacon pointed out, is that while Indianapolis has a good building code, Marion County has not had adequate code enforcement facilities, and as a consequence in later years when the city may annex some of the presently growing communities, it will acquire much faulty construction.

Dan E. Pierce, chairman of the committee, said that although the Indiana code is among the best in the United States, it does not apply to residential building. However, he pointed out, local governing bodies such as town boards, county commissioners and city councils may enact ordinances adopting the state code.

◆

Monongahela River work promoted by new group

The Ohio Valley Improvement Association has been re-organized to aid projected improvements in the Monongahela River—including the substitution of three modern dams for six present dams in the river.

According to an announcement last week, the association proposes to "foster the commercial, industrial, and social development of the Ohio River Valley; to advocate the conservation, control, purification, development and use of the water resources of the Ohio Valley and of the nation; to assemble and disseminate information concerning the Ohio River Valley and all other river valleys in the nation which will tend to influence action for further permanent improvement of navigation; to preserve constructive competition in the field of transportation."

Col. Walter E. Lorence, formerly Pittsburgh district engineer for the Army Corps of Engineers, has become executive vice-president of the incorporated association. Capt. C. S. Barrett of Cincinnati, Ohio, is president.

Cornerstone Placed — The cornerstone of the new 26-story home office of the John Hancock Mutual Life Insurance Company of Boston, Mass., was put in place recently. Steelwork for 23 stories has already been completed, and the job of facing the structure with stone is well under way. Due to be completed in 1948, the structure will be Boston's tallest building.

Minnesota starts work on huge building plan

Engineers and architects in Minnesota have begun work on a $12,175,000 state building program, said to be the largest in the history of the state.

Work on some of the major jobs will start by next spring, but the elaborate program for expanding the state hospital at Rochester may take nearly two years, since the problem there is to replace units one by one without interfering with the hospital's care for its 1,400 patients.

Nearly every structure at Rochester will be replaced by the time the $5,000,000 job is completed. The planning contract was awarded to Ellerbe and Company, St. Paul.

◆

Safety engineers create new professional group

John S. Shaw, director of safety, Hercules Powder Co., has been elected president of the newly organized American Society of Safety Engineers, which became an independent organization at its recent annual meeting in Chicago.

The National Safety Council, of which the society has been an engineering section for 23 years, will continue financial support, and headquarters of the American Society of Safety Engineers will remain at Chicago.

Canada reorganizes engineering departments

Canada's Department of Mines and Resources, one of the largest federal governmental agencies, has been streamlined according to an announcement of Resources Minister Glen.

All dominion survey activities and many special engineering services come under this department, which is responsible also for national parks, the dominion forestry service, and the Northwest Territories and Yukon.

Two new major branches of the department will be the first result of the reorganization. The first will be the Mines, Forests and Scientific Services Branch to be headed by W. B. Timm; the second is to be the Lands and Development Branch to be headed by R. A. Gibson.

J. M. Wardle who has up to now headed the surveys and engineering division of the department becomes director of special projects, in charge of all major construction projects for the department, and representing it on a number of boards and commissions, including the Eastern Rockies Forest Conservation Board, the International Boundary Commission and the Northwest Territories Power Commission.

This last named body has not yet been appointed but it is very shortly to be set up in connection with power demands in the northwest territories, chiefly in the Yellowknife gold mining area. The dominion government is building a small water power plant in that region, at Snare River; further extension of this power service may be necessary. All three directors have served with the Department for many years.

◆

Greater power potential seen for Southeast

Full development of the water resources in Georgia and its adjoining states would produce more power than is generated throughout the entire TVA system, Col. George W. Gillette, division engineer of the U. S. Corps of Engineers, told a group of Atlanta civic leaders on Oct. 15.

"When this development is completed," the engineer said "we shall see the South not as the economic problem No. 1, but as the nation's top economic opportunity."

Colonel Gillette, who directs the work of Army Engineers throughout the Southeast, referred to the full utilization of the resources of the Chattahoochee, the Savannah, the Coosa and the Altamaha rivers as the key to prosperity in that part of the country.

OBITUARY

John H. French, 54, industrial engineer and head of the John H. French Construction Co. of New York City, died Oct. 22. He had specialized in construction of large industrial buildings. Among the structures built by his firm was the Republic Aircraft plant at Farmingdale, L. I., N. Y. He was a graduate of Cornell and served as an ensign in the Navy during the first world war.

William H. Blanchard, 81, retired civil engineer, died at Fuquay Springs, N. C., October 18.

Robert H. Jones, 78, who retired in 1943 after many years' service as city engineer of Independence, Mo., died Oct. 15.

Joseph A. Tobin, 53, contractor on roads, sewers, viaducts and bridges, died at Kansas City, Mo., Oct. 15. His largest contract was for the runways of the Fairfax Airport, Kansas City, a $2,500,000 job.

Col. Graham B. Bright, 59, of the Army Corps of Engineers, who had served in both world wars, died Oct. 20 in Washington, D. C. A graduate of Virginia Polytechnic Institute in 1911, Colonel Bright served as major in the 6th Division, Engineers, in the first war. Between the wars, he was on the staff of the 29th Division at Fort Meade, Md., for several years. He had served for more than a year in the office of the Inspector General of the Army in Washington.

Gordon Innes Mackenzie, 54, city engineer of Wheaton, Ill., since 1931, died Oct. 20. He had been a member of the Wheaton park board and its president since 1939.

Charles O. Quinn, 56, Columbus, Ind., subdistrict superintendent for the Indiana State Highway Commission, died Oct. 19. He served 11 years in the right-of-way and procurement division, eight years as Columbus city street commissioner and four years as subdistrict superintendent with headquarters at Columbus.

H. H. Boomer, 91, retired San Francisco railroad contractor, died Sept. 22. With the firm of Winters, Parsons & Boomer, he did considerable work for the Great Northern, Northern Pacific and Canadian Pacific. In combination with Grant Smith, his firm built the S. P. & S. through the Snake River canyon and put in the second Cedar River pipe line for the city of Seattle. Mr. Boomer was later associated with the construction of the Basano Irrigation Project for the Canadian Pacific, with extensive highway work for Idaho and bridge work for Montana. He also was connected for a time with construction of the Bucks Dam on the Feather River in California.

William E. Greene, 82, former building contractor of Utica, N. Y., died recently in Albany. He had served as secretary of the National Contractors Association.

Angus W. Robertson, 73, president of Angus Robertson Ltd., Montreal, Que., and Toronto, Ont., died Oct. 22 at Toronto. For the last 40 years he had been in general contracting. Among the larger undertakings constructed by him were the Welland, Trent and Soulange Canals and Rockcliffe Airport.

Gordon Grant, 82, railroad civil engineer, died at Toronto, Ont., Sept. 27. He had done railroad construction in Canada, Argentina and Florida. In later life he was chief engineer of the National Transcontinental Commission and then joined the staff of the Canadian National Railways at Toronto, retiring in 1933.

George W. Green, 60, for 26 years municipal engineer with the Panama Canal, died at Panama Oct. 17. He had complete charge of design, construction and operation of the canal's water, sewer and street systems. He had also served as adviser to the Panamanian government and as well as to that of Costa Rica.

MAJOR MEETINGS

American Institute of Steel Construction, 25th annual convention, Roney Plaza Hotel, Miami Beach, Fla., Nov. 10-13.

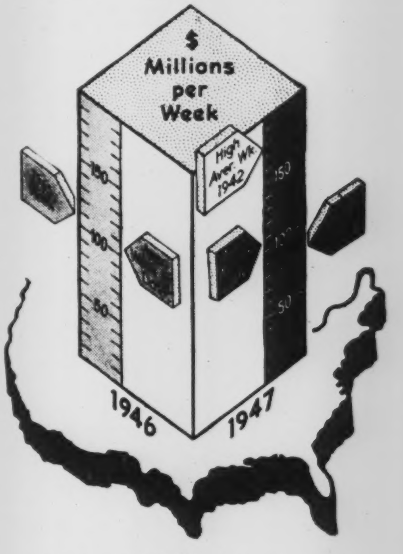
National Association of Housing Officials, 14th annual meeting, Hotel New Yorker, New York, N. Y., Nov. 17-20.

Highway Research Board, 27th annual meeting, National Academy of Sciences and National Research Council, Washington, D. C., Dec. 2-5.

National Society of Professional Engineers, Statler Hotel, Buffalo, N. Y., Dec. 4-6.

Society for Experimental Stress Analysis, annual meeting, Hotel Pennsylvania, New York, N. Y. Dec. 4-6.

CONSTRUCTION ACTIVITY



As Reported this week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Oct. 30 1947	Cumulative 1947 (44 wks)	1946 (44 wks)
Federal	$3,834	$523,877	$534,064
State & Mun.	44,894	1,486,565	1,236,654
Total Public.	$48,728	$2,010,442	$1,770,718
Total Private	33,509	2,671,049	2,776,636
U. S. Total.	**$82,237**	**$4,681,491**	**$4,547,354**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1947 (44 wks)	1946 (44 wks)
Waterworks ...	$2,285	$93,412	$95,625
Sewerage	1,815	115,724	96,416
Bridges	5,114	161,687	115,199
Highways	18,117	685,039	681,026
Earthwork, Waterways	2,544	249,642	295,638
Buildings, Public	17,232	494,912	342,683
Industrial ...	14,020	752,461	940,313
Commercial .	18,112	1,559,397	1,661,240
Unclassified ...	2,998	569,217	319,214

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1947 (44 wks)	1946 (44 wks)
NON-FEDERAL	$2,025,870	$1,281,126
Corporate Securities	782,127	358,047
State and Municipal	996,032	698,079
Fed. Aid Highway.	247,711	225,000
FEDERAL	818,729	1,714,695
Total Capital	**$2,844,599**	**$2,995,821**

ENR INDEX NUMBERS

Index Base = 100	1913	1926
Construction Cost. Oct.'47	424.41	204.01
Building Cost .... Oct.'47	320.58	173.30
Volume .... Sept.'47	255.	112.

EDITORIALS

VOLUME 139 NUMBER 18

October 30, 1947

Back to Wheelbarrow Construction

CONSTRUCTION in recent years has prided itself on having passed the wheelbarrow stage and progressed into the mechanical age. But in New Jersey there seemed to be a throwback in the process of evolution last week as common laborers walked off a Geo. A. Fuller Co. job at Milburn in protest against chuting concrete directly from transit mix trucks into forms below street level. The workers insisted that the concrete be wheeled, and—after a shutdown—it was wheeled. Union representatives claimed that the principle of not placing concrete directly from trucks is established in their working rules, and no change could be tolerated. Probably the general reaction of most constructors is that "they wouldn't get by with that on my job," but the appalling fact is that in almost every locality workers are getting by with this or that item of expensive featherbedding. It is essential that every one connected in any way with building operations cooperate to resist such returns to wheelbarrow construction. Resistance will cost money to contractors, and it will mean expensive delays in completion to owners, but every make-work action agreed to is one more rung in a cost ladder that can only lead to pricing construction out of its market.

Tackling the Traffic Problem

EVIDENCE of growing recognition of the seriousness of traffic conditions in our cities is found in the organization of a committee on urban transportation by the U. S. Chamber of Commerce. Alleviation of traffic congestion will be a first objective of this group, but its assignment covers the related subjects of freight handling and improvement of mass-transportation facilities. This committee would serve a useful purpose if it did nothing more than bring home to local chambers of commerce, businessmen's associations and civic clubs the increasing seriousness of traffic congestion and the need for them to give active backing to measures designed to relieve it. Under the current federal-aid program, $125,000,000 is provided for highway construction within city limits, but this money does not become available until it is matched dollar for dollar with local funds. Hence the need for active pressure on state legislatures or city councils. Also, the state highway departments are hard pressed for engineers to make surveys and prepare studies for new work. They would welcome a local program under which private engineering firms were to be engaged to prepare plans for new highway facilities to take traffic off congested streets. Such a program cannot succeed without enthusiastic support from local civic groups and the local press.

Bad Habits Difficult to Break

LABOR PRODUCTIVITY continues to improve, but only slightly from extra effort on the part of the individual workman. Why is this so and what can be done about it? Worker laziness is probably mostly due to bad habits acquired first during nearly a decade of depressed business. Unfortunately, neither war construction nor military service did much to break the habit. Many workmen have forgotten how good they were, and fail to realize how poor they are. Only a jolt of some kind apparently can change the situation. A recession in business, wherein there would be more workmen than jobs, would provide such a jolt. No one wants that. A tougher firing policy—work harder or get off the job—is a better alternative, assuming, of course, that the contractor's own supervisory personnel have handled the men fairly and wisely in the first place. If there is any doubt on this score, construction management might well look into the possibilities of foreman training, as practised in other industries. Better supervision can go a long way toward educating workmen on their responsibility for turning in a fair day's work. For the worker is not vicious in his laziness. He is lazy because he is in the habit of loafing. In one way or another that habit must be broken.

Municipal Engineering Careers

WHAT INDUCEMENTS are there for a young man to seek a career in the field of municipal engineering? In this period of high employment when there are more jobs than men to fill them, the question is of more than academic interest. Municipal administrators throughout the land properly are alarmed over their inability to attract young engineers to staff their public works operations. Frankly, they have very little to offer to a man with professional training and aspirations. Municipal salaries are pitifully inadequate, opportunities for advancement are limited and morale is undermined by petty political maneuvers. Small wonder, therefore, that young engineers of ability and promise find little incentive to enter municipal service. If our public works are to be competently managed, some way must be found to counteract the unfavorable circumstances that attend affiliation with such operations. This problem, with its many ramifications, is one that challenges the attention of our professional societies.

National Representation for Engineers

ONE of the most constructive steps toward better representation for engineers that could be taken at this time would be to admit the National Society of Professional Engineers to full membership in the Engineers Joint Council. That council now is made up of the president, most recent past-president and the secretary of the ASCE, ASME, AIEE, AIME and AIChE. The only voice the NSPE has had in its deliberations was on its committee on the Economic Status of the Engineer. If professional solidarity is to be advanced more rapidly, and injurious conflicts avoided, the NSPE should be put on an equal footing in EJC with the five national engineering societies.

Admission of the NSPE has been under consideration for some time, but was objected to on the ground that it would result in dual representation on EJC for many engineers, especially among civil engineers; actually, however, the admission of NSPE would bring to the councils of EJC the thinking of men who now have little voice in affairs of the American Society of Civil Engineers. Consequently, that agency would be more truly representative of all engineers than it is today.

The weakness of the present set-up is that both the Engineers Joint Council and the National Society of Professional Engineers act as the spokesman for engineers on national issues. Obviously, conflicts that might harm engineers could grow out of such an arrangement. The risk of that happening will increase as NSPE grows in size.

As was noted in an editorial "Face the Facts" in our issue of Oct. 2, the NSPE has a long way to go before it becomes truly national in character. Nevertheless, it is growing and is enlisting the interest of an increasing number of men in positions of influence. This means that more and more men may be turning to it for action on national matters in years to come.

Today there is need for both the council and the national society because each has jobs cut out for it that the other cannot do. Hence the need for the closest possible cooperation between the two organizations. Giving the top officers of the NSPE seats on the council should help each organization to serve the profession more effectively.

Reparations in Bridge Know-How

INTERESTING German military trusses are being used effectively in replacing some of the Rhine River spans wrecked in the war, as outlined in an article in this issue. Only a few of our Army Engineers know anything about these trusses first hand, and not many more have had an opportunity to study the single report that has been made on them. Isn't our occupation army missing an opportunity here?

Training in actual bridging operations is not easily given to our Army Engineers, but in the German situation is a made-to-order project. Not only could a relatively large group of officers acquire useful information on German military bridges, but new American military designs could be built and field-tested as well. Since the Germans pay for the bridges in any event, this would be a way for us to collect some reparations—learn-while-you-earn, so to speak. Col. Heath Twitchell, until recently in command of the only engineer bridging regiment in the European Command, favors such an idea. His experience in working cooperatively with German engineers on Rhine bridge plans indicates that practicable working arrangements are possible.

The last war caught our forces without a useful fixed bridge of any type, and we were saved only by the British Bailey and UCRB. Army Engineer research at Belvoir, Va., and Yuma, Ariz., is currently remedying this bad situation, so that presumably some new designs are available for such unique field testing as seems possible in Germany. Both the Department of National Defense and the U. S. Military Government in Germany should look into the merits of getting some reparations by way of bridge training for our Army Engineers.

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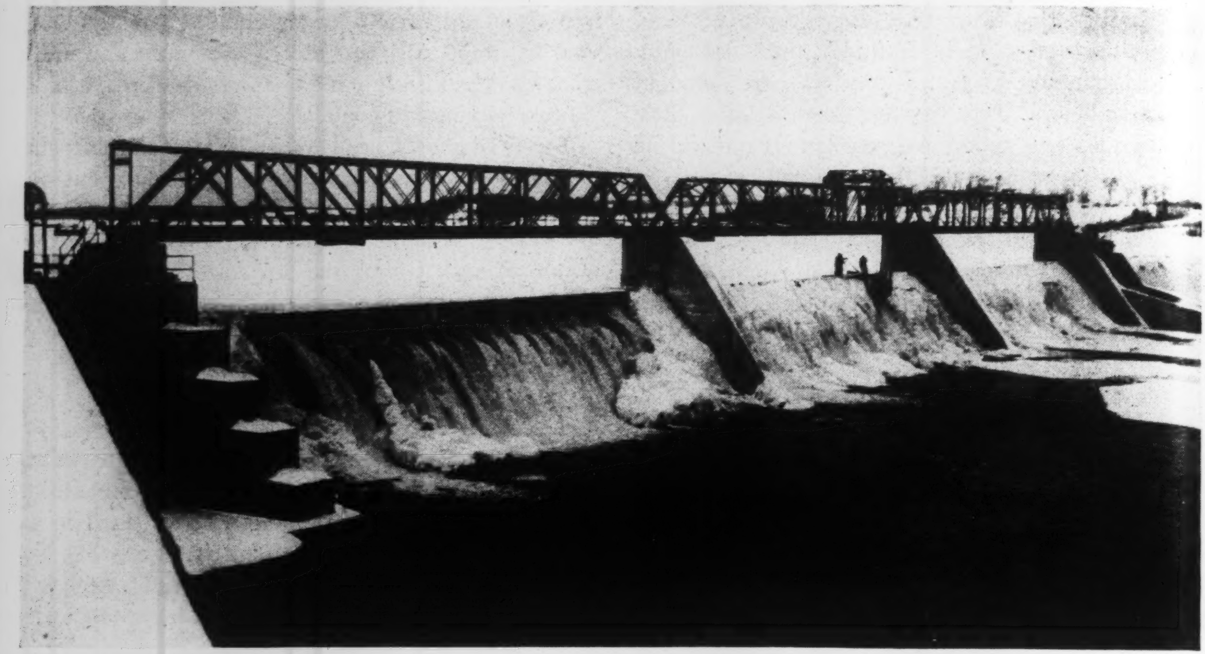

Fig. 1. New flashboards, with operating bridge and gantry, increase effective head of 35-year old power dam.

Ingenious Flashboard Replacement On Old Concrete Dam

Howard B. Fleming

Construction Superintendent and Civil Engineer,
W. H. Hinman Inc., North Anson, Me.

***Contents in Brief**—Holding pool level 2 ft. above crest by existing flashboards, an old concrete dam is leveled and topped by piers for a new flashboard structure. Navy pontoons provide floating plant. Precast concrete forms used to lay dry the upstream face of dam for pier extensions. Ingenious device assures precise leveling of dam crest.*

A NEW FLASHBOARD structure for a concrete dam recently installed by W. H. Hinman, Inc., for the Central Maine Power Co., called for unusual operations in cofferdamming and crest leveling for flashboard bearings. The location of the work was the Shawmut Dam at Fairfield, Me., and the completed structure is shown by Fig. 1.

Shawmut Dam was one of the first hydro-electric developments on the Kennebec River. Built in 1912, it has a gravity section about 1,000 ft. long and 30 ft. high, with a log sluice in the center. The effective height has been increased by 4.0 ft. flashboards on pins, and these have usually been lost two or three times a year because of ice or flash floods. Decision was made to install hinged flashboards from the west end to the log sluice, a distance of about 360 ft. to be operated by a gantry on a bridge. The bridge has three spans and the gantry rolls over it on rails welded to the floor beams which extend about 2 ft. on each side. Actual operation of the boards is by a large hook on a winch. This is guided by a man lowered from the gantry in a car, who guides the hook behind the boards with a rope, either to raise or lower them, and places the braces with a pike pole.

The bridge is carried by three piers and a small abutment built on top of the west end of the dam. The piers are 5 ft. wide and 15 ft. above the crest of the dam. They extend upstream of the face 6 ft. and below the crest on the upstream side 4½ ft. As water was carried 2 ft. above the crest behind flashboards during construction this meant cofferdamming 6½ ft. The piers slope down parallel to the downstream face to footings poured on the ledge in front of the toe of the dam. The concrete of the old dam was cut in 2 ft. steps and doweled to carry the piers. The cutting was done with jackhammers and paving breakers and because of the extreme hard-

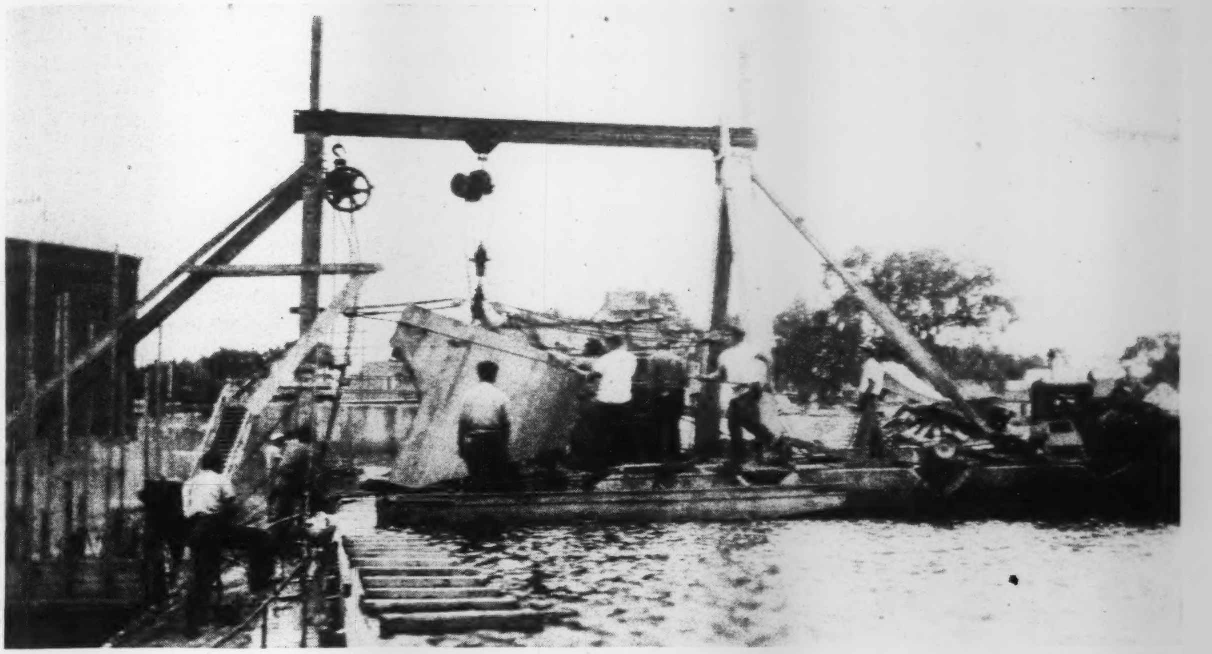

Fig. 2. Placing combination form and cofferdam of precast concrete for upstream underwater part of a pier nose.

ness of the concrete was a major operation.

Because of the location of the headworks and powerhouse at the end of the dam, access to the work from land would have required a large amount of falsework and it was decided to use floating equipment. A four by twelve combination of surplus Navy pontoons gave a scow 29x73 ft. with a capacity of 175 tons. (Fig. 3.) This was very stable.

A small crib dock was built into the river to give depth enough for the loaded scow to land. To maneuver, a two-drum gasoline hoist was cabled down to the deck and haul cables run both ways to a deadman on shore and to the log sluice on the dam. Upstream of the work, a cable was strung from a shear on the shore to a crib in the river, approximately parallel to the dam. Two 1-in. ropes attached to the two ends of the scow and rolling on sheaves on the cable were used to counteract the pull of the current. Difficulty was experienced at first from the ropes snagging on the bottom. This was eliminated by floats on the ropes.

All operations were carried on from the scow except the drilling and cutting. For this, a 3-in. pipe line was strung along the crest of the dam and air pumped from three compressors tied together on shore. Concrete aggregate was dumped directly on deck by trucks and enough could be stocked to pour about 40 cu. yd. Concrete was chuted below the crest of the dam and for the top of the piers it was placed by hoisting the buggies with a swinging gin pole operated by the hoist on the deck.

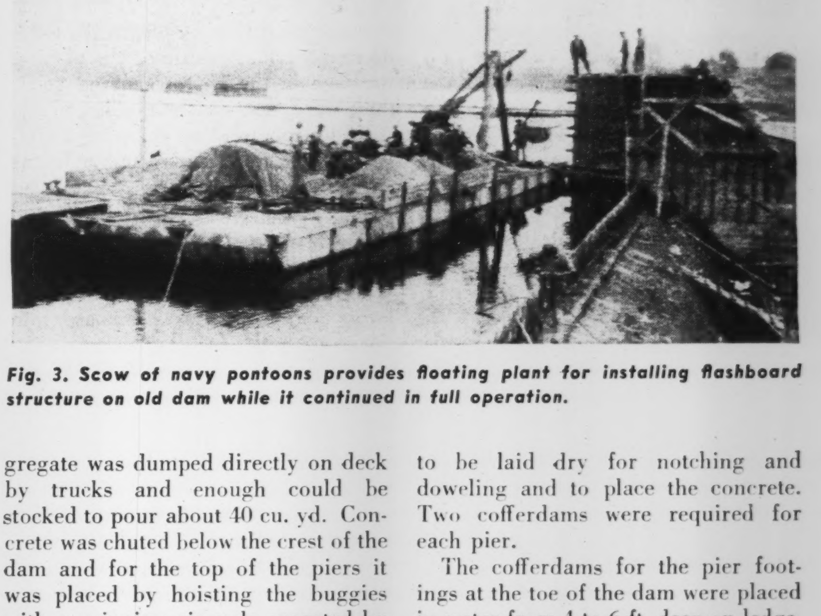

Fig. 3. Scow of navy pontoons provides floating plant for installing flashboard structure on old dam while it continued in full operation.

Cofferdam construction

As shown by Fig. 1 and 2, the piers for the operating bridge extend both upstream and downstream beyond the profile of the dam section. Also the lower parts to the front and back are under water. For these parts the dam section and the toe rock had to be laid dry for notching and doweling and to place the concrete. Two cofferdams were required for each pier.

The cofferdams for the pier footings at the toe of the dam were placed in water from 4 to 6 ft. deep on ledge. This rock had been scoured very unevenly but was perfectly clean. To fit the ends of the plank to this ledge a small rack was made of $1\frac{1}{8}$ in. strap iron which would fit down between the wales where the plank was to go. About a dozen slats $\frac{3}{4}$ in. wide were put in this and the whole set on the bottom. The slats were driven down individually and there clamped in po-

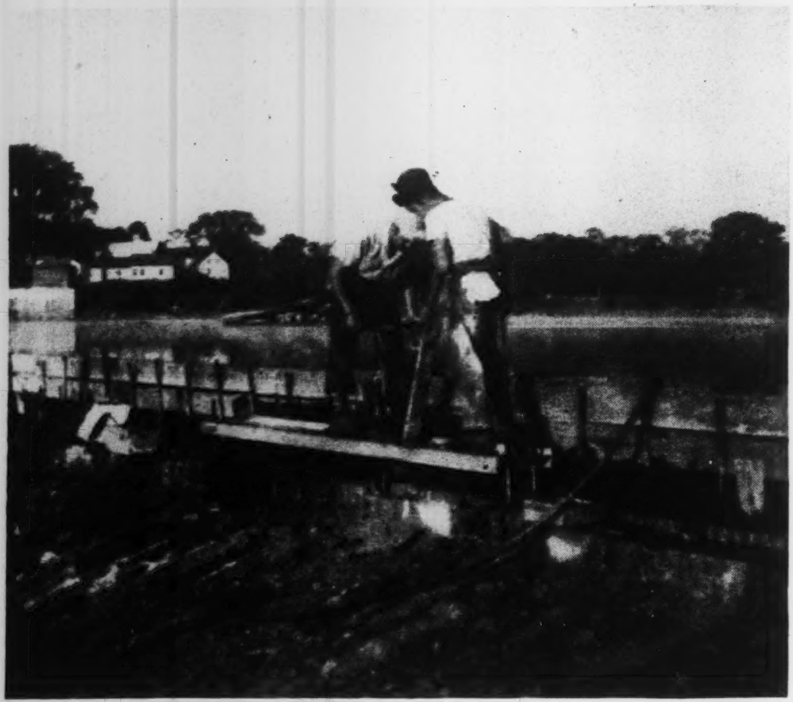

Fig. 4. Guide frame used for cutting dam crest to exact level for installing flashboard hinges

sition. When this rack was taken up a profile of the bottom could be marked from it and the plank to be placed hewed to fit the ledge. By doing this, tight dams were placed with a single line of plank and some sandbags around the bottom.

The cofferdams for the pier noses presented a major problem because of flotation. The bottom of the river upstream of the dam is covered with debris which ruled out as impracticable sheathing driven all the way down. Wood and steel coffers hung on the upstream face were considered but the uplift was so great that an extreme amount of bracing and tying below water would be required. It was finally decided to build them of concrete with the inside the neat size of the finished pier nose. These units would be practically weightless when pumped and could be hung on the crest of the dam, thus eliminating diving operations.

The shell of the coffer was 5 in. thick reinforced for water pressure and erection stresses. Pad eyes were cast into the concrete which fitted over 1½-in. bolts set into the crest of the dam. A completed nose weighed about 3½ tons. Forms for these were built on the scow and the concrete poured there. Because of the placing problem in the narrow curved space they were cast on their sides.

The forms were set by using a trolley on a 12-in. I-beam and a heavy chain fall. An A-frame was erected on the barge and a gin pole, braced and guyed, on the crest of the dam (Fig. 2). The 12-in. I-beam was then placed between the two after the barge had been tightly moored into position with hand winches. The shell was picked up with a three-legged hitch by the 5-ton fall which was hooked on the trolley. The whole was then rolled clear of the scow and righted by using a smaller fall on the leveling hitch and lowering this off. Doing this put the shell in position to be lowered onto the bolts when it was rolled over them. As a close fit was desired over the bolts, two of the shells had to be raised and the holes in the pad eyes enlarged to fit over them. Aside from this no difficulty in setting them was encountered.

After the shells were set they were pumped quickly with a 4-in. pump. The pressure jammed them against the face of the dam and caulking the edges with oakum made them practically water tight. When the installation of dowels inside the nose was complete and the cutting of the dam was done, concrete was poured inside the shell. The inside was painted with oil to eliminate any bond and a cable was pulled tight around the top of the nose back to anchors in the dam as a safety measure. However no movement was apparent. After the dam had been poured two days, forms were extended up and the piers completed.

These cofferdams would have been about a foot below normal water with the 4-ft. flashboards in operation and there was considerable question about removing them at all. However the pad eyes were finally cut loose with a paving breaker and the shells pried loose. As the water above the dam is deep they were simply dropped. The exposed concrete showed the original form marks of the pier nose forms and appeared the same as the concrete which had been formed with wood.

Leveling the dam crest

For the bearings and seal planks of the flashboards the crest of the dam had to be cut 3 in. and bushed to exact grade for the whole length of the work. To do this, frames 10 ft. long and 18 in. wide were built of heavy angle iron. (Fig. 4). Threaded rods were grouted into the crest of the dam to hold these frames which were adjusted to exact height by double nuts on the threaded rods. On the frame a riding plate with a series of holes laterally was put and special drill rods with a collar welded on them used for the drilling and bushing.

With the rack set at the right elevation a series of holes was drilled to exact grade in the crest. This was done by running the drill down till the collar on the shank came up on the riding plate. These were smoothed out by moving the drill around as it was hammering. The result was very satisfactory.

The hinged boards and steel superstructure were erected from the scow with a truck crane. A full dismantled span of steel weighing about 30 tons was taken to the dam at one trip.

For the Central Maine Power Co., the work was under the supervision of the maintenance department with Albert Howard engineer in charge. Raymond Hunter was field engineer. The author was in general charge for the contractor with N. D. Moon foreman in the field.

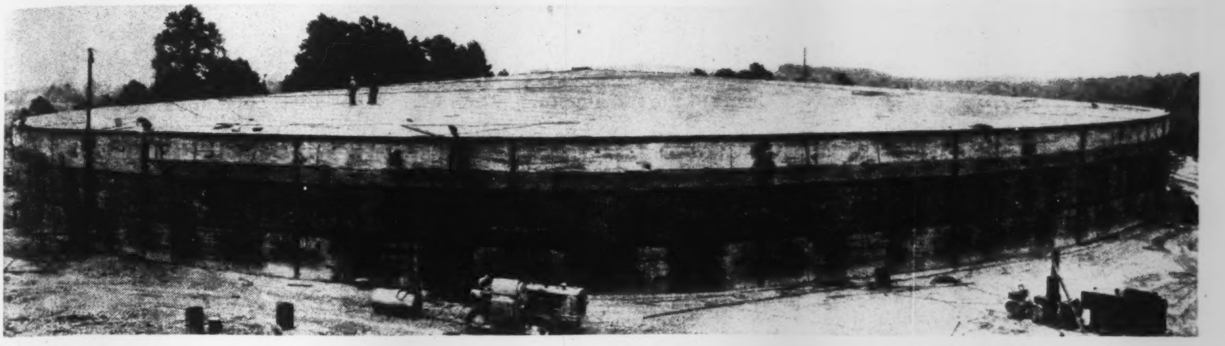

Fig. 1. Shown in a composite photograph, the country's largest steel reservoir is being built near Washington, D. C.

Largest Steel Plate Reservoir Is Built in Ten Weeks

Contents in Brief—*A 10-mg. covered steel reservoir with a 292-ft. dia. all-welded shell was built for the Washington Suburban Sanitary Commission in ten weeks by a 25-man crew, despite slow delivery of materials. To reduce corrosion of the ¼-in. thick bottom plate, the tank was placed on a thin layer of sand. Lower sidewall plates were erected by means of a crawler tractor equipped with a side boom, and assembly of roof framing supported on 141 columns was simplified by using bolted connections and by raising steel with two tower-mounted derricks moved manually.*

A 10-MG. ALL-WELDED steel water supply reservoir was completed recently near Seat Pleasant, Md., by the Washington Suburban Sanitary Commission. Design, use of steel plate and size of this structure—possibly the largest steel reservoir in the United States—dictated that small construction crews be used in its erection. On this basis, a procedure was developed that resulted in both economy and speed of construction.

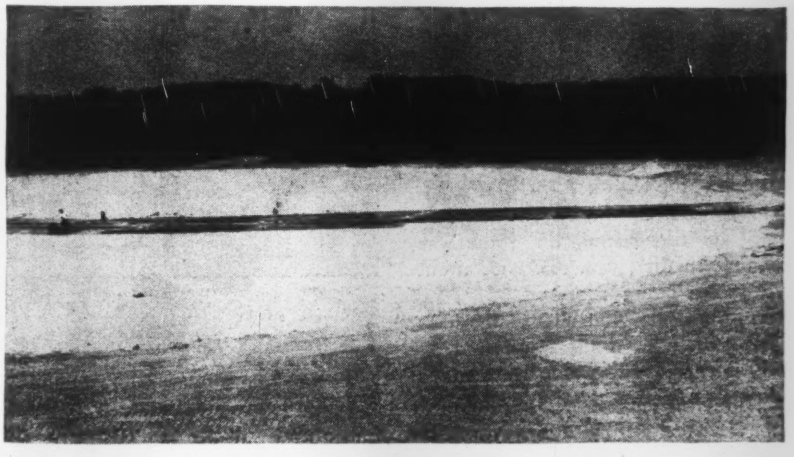

Fig. 2. In constructing the bottom of the tank on 2 in. of sand, an 8-ft. strip of steel plate was laid diametrically across the site and then added to in each direction. Lap welding was used for jointing.

Before selecting a steel design, various reinforced-concrete reservoirs were considered. Steel was chosen finally because of economy and insurance against leakage. Also, maintenance costs are expected to be low.

Large diameter structure built

The project is located in a hilly area of sufficient elevation so that a shallow reservoir could be used. Therefore, a large area was leveled to permit construction above ground of a covered reservoir of 292 ft. dia. and with side walls 21 ft. high. The roof consists of a flat cone supported on 141 interior columns and the sidewalls. Except for bolted connections in the roof framework, the structure is of all-welded construction.

Since the water load will not be large, ¼-in. plate was selected for the floor. To reduce corrosion on the underside of the bottom plate, the clay subgrade was surfaced with 2-in. of sandfill. The bottom is sloped on a 0.5 percent grade to the center of the reservoir where a sump 6 ft. in dia. and 3 ft. 6 in. deep is provided to carry away any water drawn upward from the foundation soil into the sand. Rainfall landing on the roof of the reservoir is prevented from getting beneath the bottom of the structure by a shallow paved gutter extending completely around the reservoir and located immediately adjacent to the outer walls. To reduce

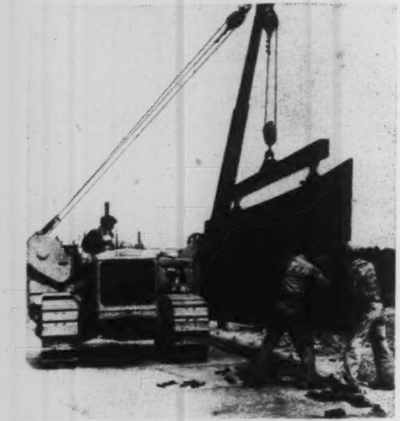

Fig. 3. **Erection of the lower rings was expedited by use of a crawler tractor equipped with an adjustable side boom.**

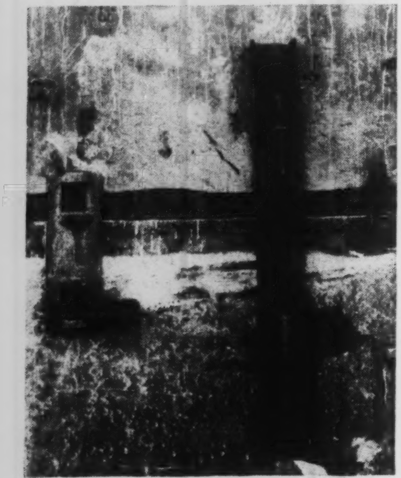

Fig. 4. **Sidewall plates were joined temporarily with key plates and channels secured in place by means of keys.**

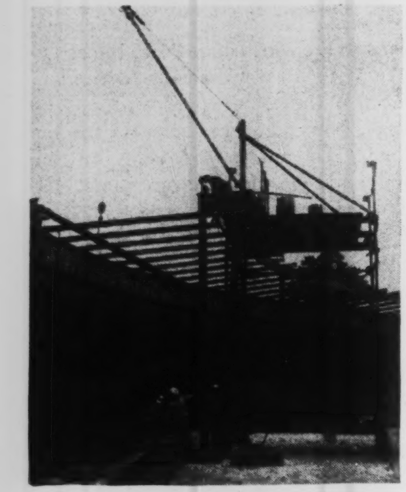

Fig. 5. **The roof framework was erected with 10-men crews using tower-mounted derricks.**

corrosion of the steel further, it was pickled by the phosphoric acid process.

Most of the steel for the bottom was delivered in 8x31-ft. sections, although some odd-sized "sketch" plates had to be used adjacent to the sidewalls. In constructing the bottom, an 8-ft. wide strip was built completely across the reservoir on the east-west diameter and then strips were added on either side (Fig. 2). At all joints plates were lapped at least 1¼ in. and joined with a single pass of ¼-in. dia. welding rod designed for flat work. General practice was to tack weld several sheets in place and then complete final welding later. In the latter operation one welder averaged about 225 lin. ft. of joint per day.

Tractor erects sidewalls

Sidewalls consist of three rings of steel plates 7-ft. wide and 31 ft. 6 in. long. The lower ring is 1 in. thick, the middle ring 0.65 in., and the top one 0.30 in. Construction of the two lower rings was expedited by use of a crawler tractor with an adjustable side boom 25 ft. long. Welders who have worked on many steel structures report that this is the first time a tractor has been used in this manner. It proved a big time saver.

Plates were lifted by means of a built-up spreader beam attached at two points by clamps (Fig. 3). As each plate was raised, it was tacked to the bottom plate so that vertical joints could be completed before joining to the bottom plate. By this method a 5-man crew, including the operator of the tractor, erected the first ring in 8 hr.

Vertical joints were butt-welded with the plates spaced $\frac{5}{32}$ in. apart by means of temporary finger bars and key plates. The first pass was made on the outside with a $\frac{5}{32}$-in. dia. welding rod. After it had been "chipped back" on the inside, the joint was completed with $\frac{3}{16}$ in. dia. rod, about five passes being required.

In joining the first ring to the base plate, ¼-in. fillet welds were used on both sides. These welds were made with a ¼-in. rod.

Progress in assembling the second ring was almost as fast as that on the first ring. These plates were tack-welded to the lower ring and vertical joints were completed before final welding of the horizontal joint. Vertical joints were made in the same manner as those of the first ring, except that only about four passes of the welding rod were required. The horizontal joint was butt welded with the first pass made on the inside with a $\frac{3}{16}$-in. rod. After back chipping, the joint was completed with six to seven passes on both sides of the wall.

Gin poles erect top ring

Because of height, the tractor could not be used to erect the third ring. Instead, two steel gin poles 40 ft. high were set up outside of and on opposite sides of the reservoir. Erection continued independently from each pole. An air-driven hoist connected to a 160-cfm. portable compressor with a 700-cu.ft. air storage tank was used to lift plates into position.

As each top plate was raised, it was mounted in three "buggies" which, rolling on the top edge of the second ring, permitted positioning. Then, having been attached temporarily to the adjacent plate, it was raised slightly at the free end, and the buggies were rolled out. Following this, four 5-in. temporary vertical chan-

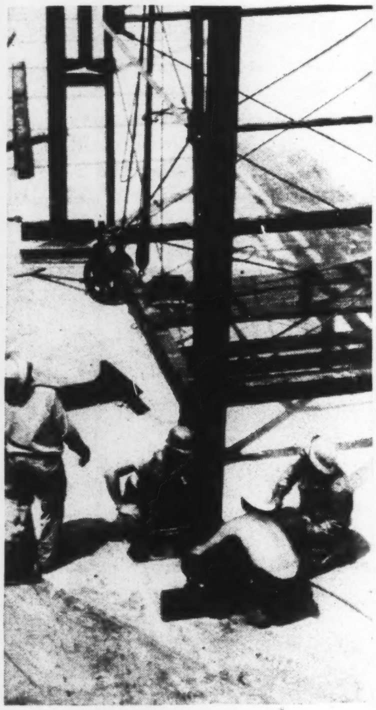

Fig. 6. **The lower end of each column is bolted to three short channel sections bearing directly on the ¼-in. thick bottom plate.**

nels about 4 ft. long were used to hold the plate upright from the middle ring (Fig. 4).

Erection of 30 plates in the third ring required less than eight hours for a crew of six men. All joints, of course, were only temporarily connected; final welding was done later.

As with lower rings, vertical joints were welded before the horizontal joint. The first pass was made on the inside with $\frac{3}{16}$-in. rod, and five passes usually closed the joint.

In making the horizontal joint, a single pass of a $\frac{3}{16}$-in. rod was made on the inside and then completed in four passes. It should be noted that uphill welding was used for vertical joints in lower and middle rings, except for the last pass, which was downhill. However, for the third ring, all passes were downhill.

Roof supported on 141 columns

The roof is supported on seven concentric circles of columns with a spacing between circles of 18 ft. 3 in. The chord distance between the columns along a given circle is about 23 ft. This layout resulted in the use of 141 columns.

A typical column is made up of a 7-in., 9.8-lb. channel and a 5-in., 6.7-lb. channel welded together at the fabricating mill to form a T section. At the top of each column a 10x10x $\frac{1}{2}$-in. plate provides connection to the roof beams. Since the roof slopes away from the center of the reservoir at a rate of $\frac{3}{4}$-in. vertically to 1 ft. horizontally, columns vary in height from about 31 ft. at the center to slightly over 20 ft. for outer columns.

Each circle of columns is joined at the top with a 15-in. 33.9-lb. steel beam, which in turn supports the 7-in. 9.8-lb. channel used for rafters. The latter are placed on the radii of the tank with the spacing at their outer ends 5 ft. 8 in. and at their inner ends 5 ft.

Roof framing was erected by means of two stiff-leg derricks mounted on individual towers about 25 ft. high (Fig. 5). Each tower was supported on four caster-mounted steel wheels that permitted manual moving (Fig. 9). Power for each derrick, which has a boom about 20 ft. long, was supplied by a small air-driven hoist mounted in the lower bracing of the tower. Air was furnished by a portable compressor.

After a column had been raised, its lower end was bolted with six $\frac{3}{4}$-in. bolts to short horizontal sections of channel assembled in the shape of an H (Fig. 6). These short channels transmit the column load directly to the $\frac{1}{4}$-in. thick bottom plate. Erection of beams and rafters followed closely behind erection of columns (Fig. 5). Beams are secured to columns at each end with two $\frac{3}{4}$-in. bolts, while rafters are bolted to short angles welded to the beams.

Roof built at rapid rate

This method of erection permitted rapid advancement. During the first day of erecting the framework, a crew of ten men using one derrick erected 9 columns, 8 beams and 32 rafters in $3\frac{1}{2}$ hours. All roof framing was completed before placing $\frac{3}{16}$-in. roof plates.

Roof plates were lifted to top of the tank by means of the gin poles and welding started adjacent to the pole. All joints were lapped 1-in. and made with a single pass of a $\frac{7}{32}$-in. rod. To distribute plates about the roof, small, air-powered winches temporarily mounted on the roof framing were used.

For welding a total of 15 direct-current, 300-amp. machines were employed. Eight were equipped with diesel-powered generators, one was powered by a gasoline engine, and six were supplied from two diesel plants, each accommodating three machines.

Tank built in ten weeks

The welding and erection crew averaged 25 men. The time required to build the tank could have been reduced by several days if supplies had been delivered on time. The reservoir, which required a total of 1,205 tons of steel, was completed in about ten weeks. The structure cost \$243,000, while the total cost of the project, including 50,000 cu. yd. of grading, was about \$300,000.

For the Washington Suburban Sanitary Commission, Harry Hall is chief engineer, and Harry B. Shaw deputy chief-engineer. On the project H. Roland Devilbiss was construction engineer.

The Chicago Bridge and Iron Co., represented on the job by A. E. Revelle and O. C. Hanks, held the contract for steelwork.

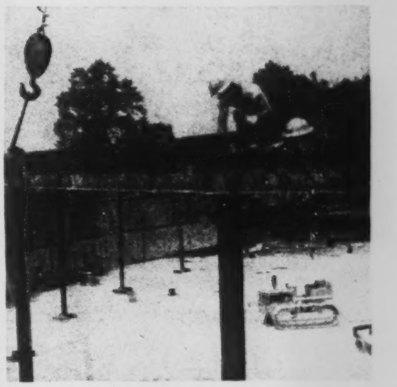

Fig. 7. Bolted connections were used to join beams and columns, while rafters are bolted to clip angles welded to beams in the fabricating shop.

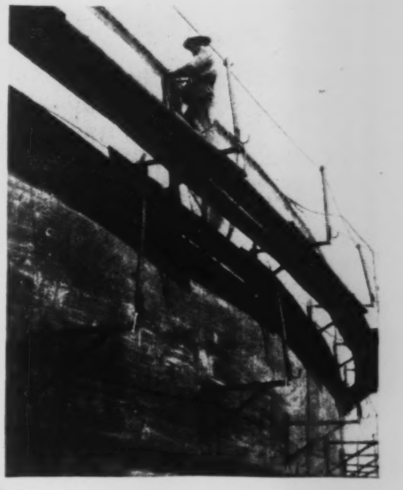

Fig. 8. A continuous scaffold was used on both sides of each 7-ft. high side wall ring.

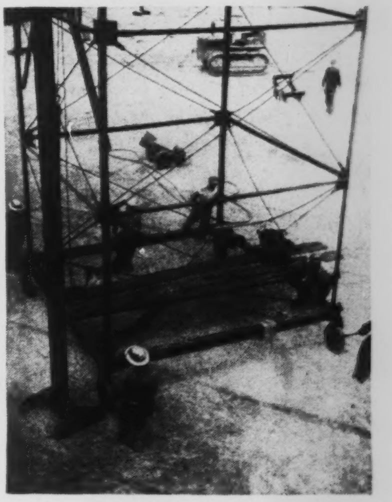

Fig. 9. Shifting of derricks was done easily by the erection crew.

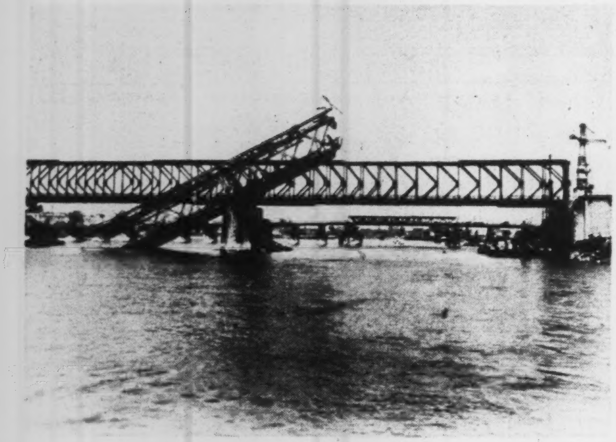

Fig. 1. At Mannheim, new long span rail bridge emphasizes bottleneck caused by temporary highway bridge beyond

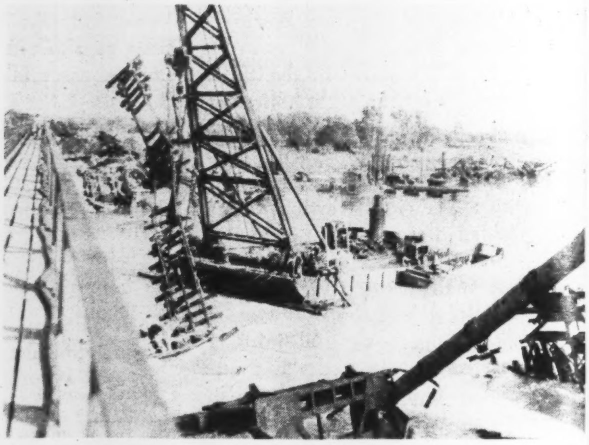

Fig. 2. A 300-ton U. S. crane cleans out Mainz South bridge wreckage alongside Marshall military bridge.

THE RHINE

II—How Its Bridges and Barges Are Being Restored

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Editor Engineering News-Record

Contents in Brief*—In this second of two articles on today's most fateful river, its present condition is assayed with respect to its future prospects. Although about half of the wreckage of bridges and barges that glutted the Rhine after the war has been removed, and about a fourth as many bridges cross it as before, traffic is still restricted by one-way bottlenecks. New bridges are being built, some of novel design and all involving interesting construction. Few are of permanent type, but the best will serve from 10 to 25 years. Rehabilitation of the Rhine is one of the fundamental jobs in the task of getting Europe back on its feet. The first article appeared in ENR—Oct. 16, 1947, vol. p. 514.*

Famous since Caesar's time as a test of bridge building skill, the Rhine became, during the past two generations, the locale of what was probably the world's greatest exhibit of iron and steel bridges. Built not only to provide a crossing for land traffic, but to avoid interference with water craft, the structures were necessarily of major size; and, because of the practice of design competitions that was followed, diverse and often novel types types resulted. The fame of the Rhine in modern times rested almost as much on its bridges as on its scenery or its economic importance as a waterway, both of which were outstanding.

Today, all of the Rhine's notable bridges are twisted wreckage, only in small part recoverable except for scrap. A single crossing exists in its prewar form after a considerable job of rebuilding. Thus the challenge that the Rhine offered bridge builders still exists, as does the necessity for bridges of a size that will permit the water traffic to pass under them safely and efficiently. Indeed, the necessity is so compelling that bridging activities to cope with it have been continuous since before the war ended.

Without bridges, the Rhine is a moat; to eliminate this condition military bridges were pushed across it with all possible speed as soon as the Allies captured its banks. Without bridges with adequate shipping clearances, the Rhine's basic peacetime function as a waterway is handicapped; to realize this improvement, the military bridges have been giving way to more permanent installations, if not of the best at least of medium term sufficiency.

This latter phase of recovery from war's devastation is now current, and it is largely with it that this article is concerned: that and the broader question of fitting the Rhine to its necessary role in the economic recovery of Western Europe.

Rhine not ready for recovery

Ruhr coal, American food and Rhine barges—if, by some legerdemain, the quantity of each could be doubled it is generally agreed that

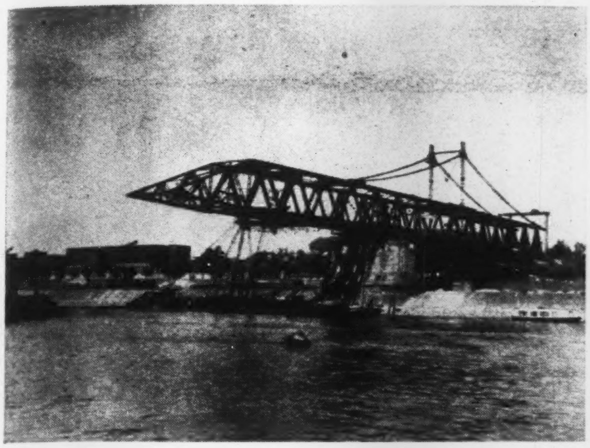


Fig. 3. Cantilevering two 310-ft, spans for the Dusseldorf-Oberkassel bridge. Identical operation from other bank.

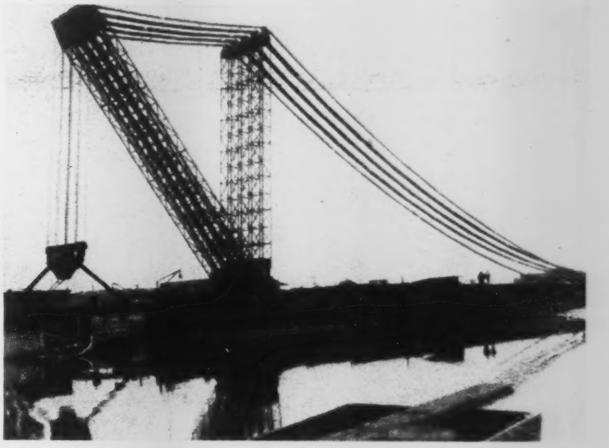


Fig. 4. Unique 400-ton French crane of five booms and five masts has greatly aided Rhine clearance operations.

this economic recovery would be assured. And yet if this magic worked too quickly it would defeat its own ends since the barges and their precious cargoes would be snarled in a traffic jam. In its present condition the Rhine is not ready for recovery.

Wreckage of the original bridges and the existence of short spans on the initial replacement structures restrict the channel by causing one-way traffic bottlenecks, and many sunken craft remain to be raised. Traffic movement is at the seemingly high rate of 13 million tons annually, (and the numerous barge tows look impressive), but when comparison is made with the prewar traffic volume of nearly 100 million tons (nearly four times peak traffic on our Ohio River or Panama Canal and comparable to the total of ore and grain shipments through the Soo Canal) the real magnitude of future requirements comes into focus. The pressing need to plan and build for a much greater traffic volume than at present is inherent in the Rhine's unique position as a primary trade artery for five different countries—Holland, Belgium, France, Germany and Switzerland—as outlined in the first article of this series (ENR Oct. 16, 1947, vol. p. 514).

Clearing the river

In so far as present traffic is concerned, it is being accommodated, also much wreckage is being removed and bridges are being rebuilt as rapidly as materials can be made available. That sufficient priority has not been given the job is an ever-present danger, but that substantial progress has been made cannot be denied. Not for a generation, perhaps never, will the Rhine again present the greatest exhibit of steel bridges in the world. But it will have some notable structures, and will continue to beckon the talents of the bridge builder and the designer.

Removal of bridge wreckage and the raising of sunken barges and tugs was the necessary prelude to restoring the Rhine waterway. Begun immediately after V-E Day, the work has been continuous ever since, the first objective being a 75-ft channel, then widening to 150 ft., and now complete removal of all wreckage. Much of the current task involves lifting of steelwork merely pulled out of the way in the first two phases of the operation. Pier debris is also being removed at a number of locations, and sunken craft raised. Nearly 700 barges have been recovered, but 80 barges and 20 tugs remain to be raised in the U. S. Zone alone.

Different procedures have been used for opening the channels. The British utilized depth charges extensively to break the tangled steelwork into small pieces that could readily

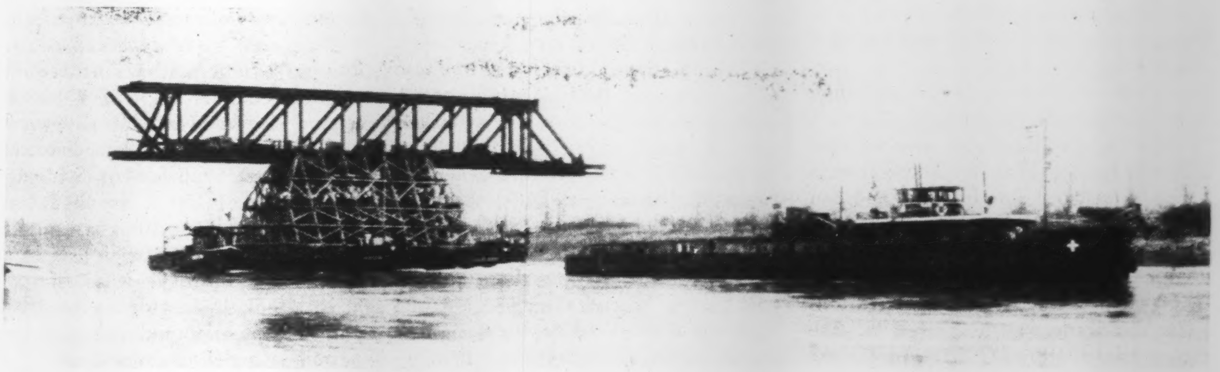


Fig. 5. Borrowed span. Towed up the river in two sections, a 336-ft. span from Brisach allowed Chalampe bridge to be opened early for rail traffic. Brisach, using shorter spans, is being converted to highway use.

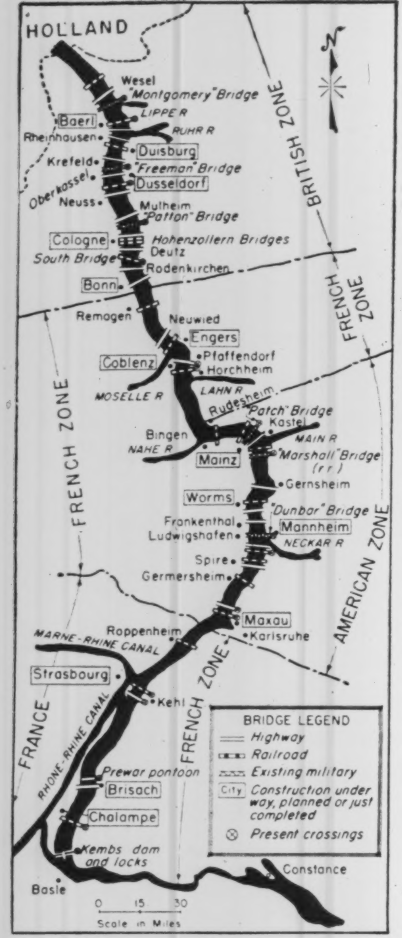

HOLLAND
Wesel
"Montgomery" Bridge
LIPPE R
Baerl
Rheinhausen
RUHR R
Duisburg
Krefeld
"Freeman" Bridge
Oberkassel
Dusseldorf
Neuss
Mulheim
"Patton" Bridge
Cologne
Hohenzollern Bridges
Deutz
South Bridge
Rodenkirchen
Bonn
Remagen
Neuwied
Engers
Pfaffendorf
Coblenz
Horchheim
MOSELLE R
LAHN R
Rudesheim
"Patch" Bridge
Kastel
Bingen
NAHE R
MAIN R
Mainz
"Marshall" Bridge (r r)
Gernsheim
Worms
"Dunbar" Bridge
Frankenthal
Mannheim
Ludwigshafen
NECKAR R
Spire
Germersheim
Maxau
Roppenheim
Karlsruhe
MARNE-RHINE CANAL
Strasbourg
Kehl
BRITISH ZONE
FRENCH ZONE
FRENCH ZONE
AMERICAN ZONE
FRENCH ZONE
FRANCE
RHONE-RHINE CANAL
BRIDGE LEGEND
Highway
Railroad
Existing military
City
Construction under way, planned or just completed
Present crossings
Prewar pontoon
Brisach
Chalampe
Kembs dam and locks
Constance
Basle
0
15
30
Scale in Miles

Fig. 6. The Rhine bridge situation, permitting a comparison between prewar and the summer of 1947.

be lifted out or would sink into holes in the river bottom. At times, holes for this purpose were made with other depth charges. The Americans, having bigger cranes at their disposal, cut bridge trusses into relatively large sections that could be hauled out. This same method was the one followed by the French who were particularly anxious to save as much steel as possible for re-use.

One crane developed and utilized by the French (Fig. 4) had 5 booms and 5 masts set side by side, and can lift 400 tons with hand winches.

Mounted on a railroad car ferry, with Rhine barges fore and aft and at the sides for additional stability, the crane was first used to save two pieces of an 1,100-ton truss span at Roppenheim. A 250-ton section was raised directly while one weighing 850 tons was dragged from the channel onto the bank. By mounting the land end of this large piece on rollers and loading it with counterweights, it was readily moved by the crane.

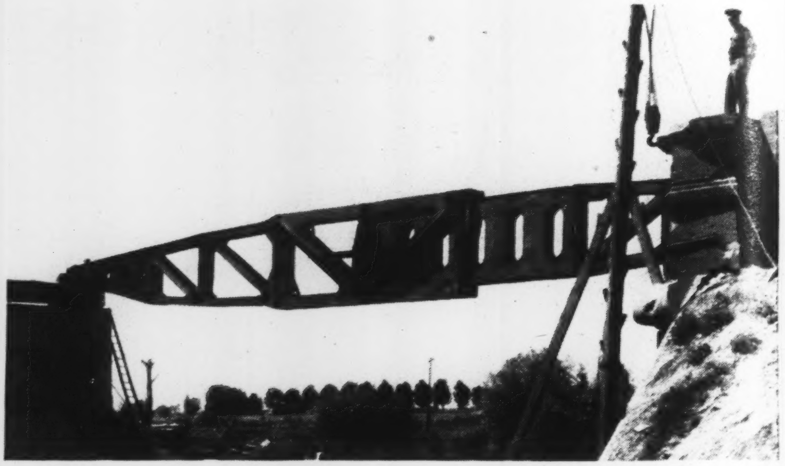


Fig. 7. From Normandy to the Rhine. This fish-belly truss being installed in the Brisach bridge approach first saw service in the floating harbor at Omaha Beach on D-Day. In the interim it was used in a temporary bridge in France.

As an indication of the magnitude of the job and the speed with which it could be done if enough big equipment were available, the Mainz South railway bridge steel in the U. S. Zone, totaling 9,000 tons, was pulled out and stockpiled on the bank in a period of 7 weeks with one 300-ton floating crane, Fig. 2.

Then and now

Before the war there were 22 railroad bridges and 22 highway bridges across the Rhine, Fig. 6. In addition, largely in the upper reaches, there were 11 pontoon highway bridges and a roadway over Kembs dam, so that a total of 53 different crossings were available.

During and after the war, 23 military bridges of various types were built and, since almost none of these was exactly on the line of a prewar bridge, 76 bridge "sites" are marked on the maps of the Central Rhine Commission in the 425 mile reach between the Swiss and Dutch borders, that is, the part of the river in the present occupied zones of Germany. Of this total of 76 sites there is present bridge "activity" at 33. At 24 sites the activity relates to design or construction of replacement bridges, while the other 9 sites represent existing military bridges, a re-established prewar pontoon bridge and the rebuilt Kembs dam crossing.

If one considers the 24 sites where design or construction is underway, it is noted that this number is a little over half of the prewar total of 44 fixed bridges. And, as before the war, they are divided about evenly between highway and railway crossings —11 of the former, 13 of the latter.

Such a record would be impressive if all of these bridges were up to prewar standards and if some of them in the design stage were not merely plans made against some unknown future when materials will be available. The prewar standard for Rhine bridges, for example, was for two channel spans of about 300 ft. each, and with 30 ft. vertical clearance over highest navigable water or 39 ft. over mean water. Most of the later bridges exceeded these minimum span lengths, and the tendency was toward putting both channels under a single long span of 500 ft. or more.

Compared to these standards, initial military specifications required a single channel span of 75 ft. and vertical clearance of 22 ft. above mean water level. This was later increased for the first replacement bridges to an opening of 150 ft. by 29 ft., and it is such structures that are now being superseded. New span lengths are governed by no definite set of standards, although as wide a channel opening as money and materials will permit is a definite objective. Presently, no new bridges are being built with less than a 185 ft. channel span, and wherever possible two such spans

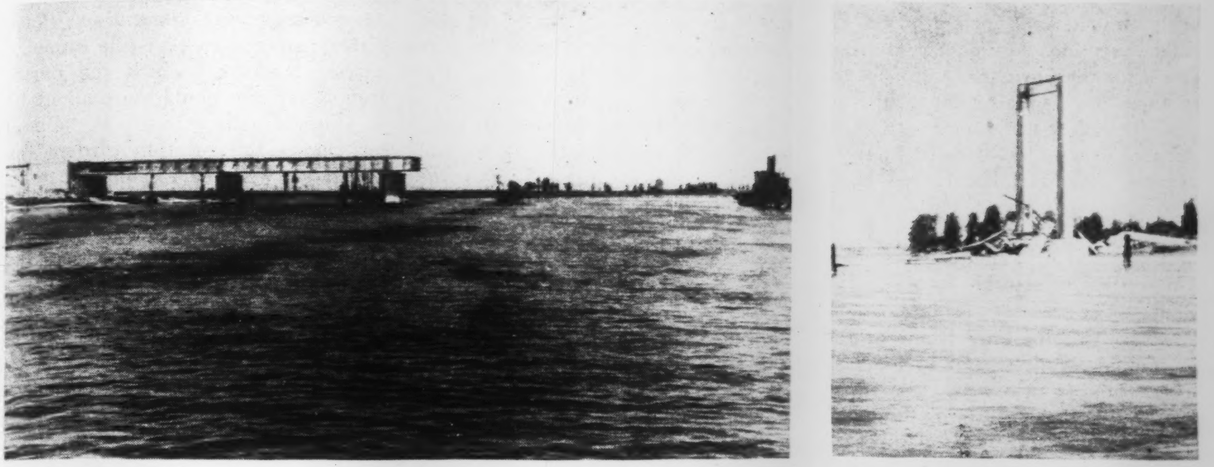


Fig. 8. Two Hitler masterpieces that won't be replaced. The two 543-ft. girder spans of the Frankenthal bridge were the longest in the world. The tower (right picture) helped support the 1,244-ft. span Rodenkirchen suspension bridge near Cologne, longest in Europe.

are provided. New vertical clearances whenever possible will be those that obtained prewar.

Three philosophies of improvement

Since all three occupying powers—Britain, France and the U. S.—have a piece of the Rhine within or bordering their zones, river bridging is governed by three different philosophies, even though there is cooperation in setting the minimum requirements for navigation. The philosophy of the French is to rebuild some kind of a bridge on the old alignment as soon as possible. If it has to be made up of a conglomeration of differing old spans, they put in the extra piers to take them. They scour the countryside for abandoned trusses, and have moved one span from one Rhine bridge to another, Fig. 5. Some of the old fish-belly trusses of the artificial harbor causeways used in the Normandy landings, which first did postwar service on French rivers, have now been brought over to the Rhine where they make good approach spans. The French must be credited with much ingenuity and hard work, which to date has produced more semi-permanent completed bridges than in the other zones.

In the American zone the original postwar philosophy was to replace the bridges we had built during the war with better crossings, but still of temporary military type. As a result, we had reasonably good bridges across the Rhine before either of the other occupying powers. But because they were reasonably good we did not hurry to replace them, so that our philosophy up to the middle of this past summer has been one of procrastination, even though we had completed designs over a year ago for superseding three of the military bridges with structures having spans in the neighborhood of 300 ft. The extenuating circumstances to procrastination in the U. S. Zone have been two: shortages of steel and the fact that only one end of the bridges in question is in the U. S. Zone. Moreover, only within the past few months, the three new bridges noted above have been put under construction.

Differing from both the French and American ideas, the British lean toward rebuilding in as permanent a state as possible and to prewar standards. Several such bridges are in process, but progress is slow because of the relatively large quantities of steel required. Whether one philosophy is better than another, only time will tell, and even then the answer may be inconclusive. In support of the British program it may be noted that their bridges are located in the industrial area where both water and bridge traffic are greatest, and a permanent bridge, even though taking longer to complete and requiring more steel, may be the proper selection.

All bridges, it should be emphasized, are being built by the Germans themselves, not by any of the occupying powers. The various military governments provide the priorities for materials, and approve and control the designs, but the Germans do the work and pay the bills out of their own economy.

A proper preliminary to consideration of the bridge rebuilding program, and some of the most interesting individual jobs is to recall the original bridges and their distinguishing characteristics. This is done in an accompanying tabulation, where the plans or possibilities for reconstruction are also noted.

A few of the famous bridges will reappear in their original form, more will be replaced by medium-term bridges that will probably give way to something better in 10 to 25 years, and a number are to be abandoned for the time being and may never be rebuilt.

A fourth class of bridge, which is certain to disappear, includes several that were built at the order of the German army for strategic purposes and thus never had an economic justification. The famous Remagen bridge, over which German supplies have moved in both World Wars to support the Ardennes battles, is in this latter class.

Rhine bridge salvage

The first problem of Rhine bridge building is that of Rhine bridge salvage. Raising collapsed bridge spans has had to be developed into a fine art by European construction men, and this is nowhere more apparent than on the Rhine. Always partial to portal frames as a prime piece of bridge erection equipment, it was natural for the Germans to attempt to use them for bridge raising operations. This they have done with considerable success at Brisach, Engers, Cologne-Deutz and Baerl, and they are proposing to use a portal frame at Mannheim. Since the work at Baerl was the first completed, it can be described as typical.

The Baerl railway bridge, below Duisburg, was the only Rhine crossing not totally destroyed in the last phases of the war. Of the three through-truss spans forming the main river crossing, only that on the east end collapsed (Fig. 9) when it was broken in the center with an explosive charge. The fact that the center 611-ft. span did not similarly collapse is attributed to a temporary pier under its mid-point, placed by the Germans in the early days of the war to keep the bridge from falling if it should be hit in an air raid.

The broken span was 350 ft. long, and came to rest with the halves still leaning against the piers. To raise the halves back to level, and re-center them on the pier bearings, a portal frame with inside dimensions of 88x88 ft. was erected over each of the broken ends. Lifting with a total of 800 tons each, applied by two pairs of 200-ton hydraulic jacks, each set acting on a pair of 18x1-in. perforated bars, (Fig. 10), the frames raised the half spans in 120 hours of jacking time. The total time, measured from the beginning of pile driving for the frame foundations until the first train passed over the bridge, was 18 weeks.

The equipment setup is shown in the accompanying illustration. Plate girder runways on pipe-pile supports carried tracks on which the portal frame carriages could move about 10 ft. longitudinally. On top of the portal frames the reaction girders for the jacks were also mounted on a carriage for transverse movement.

Lengthwise movement of the frames was particularly necessary for the right half of the truss span, in falling, had kicked backward (east) over the pier; the transverse movement of the lifting carriages was required on the left-half of the span which was displaced about 16 ft. from the centerline.

The remaining essential parts of the lifting equipment consisted of temporary rotation points at the pier ends. At the east end, where the span had kicked backwards, a steel

PRESENT STATE OF PREWAR BRIDGES

(References are to main spans only, not approaches. Figures at left denote mileage below Swiss border)

17.5 **Chalampe** (railway) — Originally three 336-ft. Whipple truss spans. Back in service. Partly reconstructed.

34.0 **Brisach** (highway) — Originally railroad crossing like Chalampe. Being rebuilt for highway traffic.

77.0 **Strasbourg** (highway)—No data on original bridge. Replaced with a timber bridge.

77.1 **Strasbourg** (railroad)—Originally three Whipple truss spans of 197 ft. each. Replaced with shorter plate girder spans on temporary piers.

103.0 **Roppenheim** (railway)—Not to be rebuilt.

119.0 **Maxau** (highway and railway)— No data on original structures. Each bridge replaced by five 200 ft. truss spans on single set of temporary piers. Trusses are French variation of SKR design.

132.0 **Germersheim** (railway) — Rebuilding postponed indefinitely.

141.0 **Spire** (highway and railway) — Originally two 495-ft. truss spans. One span raised and saved. No present plans to complete.

158.0 **Mannheim** (highway and railway) — Common piers, each bridge contained three 295-ft. Whipple truss spans. Railway bridge replaced by three SKR spans. Highway bridge scheduled for early replacement.

163.0 **Frankenthal** (highway) — Originally two plate girder spans of 543 ft. each, probably longest such spans ever built. One span standing, other collapsed during construction. Will not be rebuilt.

169.0 **Worms** (highway)—Widely known for its heavy stone portal towers. Three deck arch spans of 285, 330 and 262 ft. No present plans for rebuilding.

170.6 **Worms** (railway)—Originally three tied arch spans of 335, 384 and 335-ft. Being replaced with five 200-ft. truss spans, like those at Maxau.

180.0 **Gernshiem** (highway) — Originally two 330-ft truss spans. German strategic bridge. To be abandoned.

202.0 **Mainz-South** (railway) — Originally four 345-ft. tied arch spans. Scheduled for early replacement with four parallel-chord truss spans.

203.0 **Mainz-Kastel** (railway) — Originally four 345-ft. hinged deck arches of 282, 322, 335, 322 and 382 ft. spans. Scheduled for early rebuilding in original form.

204:7 **Mainz-North** (railway)—Originally five tied arches of 308 to 380 ft. span. No present plans for rebuilding.

220.0 **Rudesheim** (railway)—Originally two 556-ft. span tied arches of unusual type over channels either side of an island. The spandrel-braced arch ribs cantilevered 26 ft. beyond the supporting piers as parallel-chord trusses and joined with similar trusses that made up the balance of the bridge. Will not be rebuilt.

259.0 **Coblenz-Horchheim** (railway) — Originally two 350-ft. wrought iron deck arches. Back in service with two divided-Warren SKR spans on original piers.

260.2 **Coblenz-Pfaffendorf** (highway)—Originally three 320-ft. spans of wrought iron deck arches. Back in service with nine beam spans of various lengths and two 207 ft. truss spans over navigable channels.

268.0 **Engers** (railway)—Originally a 617 ft. tied arch cantilever as at Rudesheim. Scheduled for replacement next year with two 240 ft. and one 135 ft. truss spans.

frame anchored to the pier and pinned to the bottom chord of the truss furnished the center of rotation. At the west pier, whose top had been sheared off when the span collapsed, a center of rotation had to be provided on falsework in the river. Utilizing a screw jack with a ball-and-socket head, this latter rotation point was initially located under the first panel point. When the span had been raised several feet the rotation point was shifted forward to the second panel point. Finally, at the location of both rotation points, short steel columns were erected which carried the span until it was seated on its permanent pier bearings.

German military bridge trusses

In addition to the raising and salvaging of wrecked spans, Rhine bridge reconstruction has been greatly benefited by standard German military truss spans found in steel shops in various stages of fabrication, or even completed awaiting shipment when the war ended. Various types of these prefabricated portable railroad spans have been discovered, the most useful for present purposes being the so-called SKR design, since it is largely composed of standard rolled sections and requires only normal instead of the close connection tolerances of some of the other types. These characteristics are also favorable to fabricating new SKR bridging in existing shops, which has sometimes been necessary.

The initials SKR stand for Shaper-Krupp-Reichsbahn, and result from the fact that a Mr. Shaper, chairman of the bridge committee of the Communications Ministry, developed the design in cooperation with Krupp for the German State Railways (the Reichsbahn) when the German production facilities during the war proved incapable of turning out the more exactly fabricated army designs in sufficient quantity. The army designs, however, furnished many of the precedents for the SKR, and since some of these special military spans are also used in the Rhine bridges they too are of interest.

The earliest of the military bridges was the RW or Roth-Wagner type developed by the Austro-Hungarian army prior to World War I and used extensively on the Eastern Front. With panels 10 ft. long and truss depth of 13 ft., spans up to 160 ft. could be used and erected by cantilevering without falsework; increas-

THAT CROSSED THE GERMAN RHINE

271.0 **Neuwied** (highway)—Original bridge of three continuous Warren truss spans of 693, 198 and 620 ft. Will be rebuilt, but time indefinite.

286.0 **Remagen** (railway)—Originally a 512 ft. tied arch with cantilever ends as at Rudesheim. German army strategic bridge. Will not be rebuilt.

300.0 **Bonn** (highway) — Originally two 310 ft. deck arches at either end of a central spandrel-braced through arch span of 615 ft. Scheduled for early replacement with continuous cellular deck girder spans of same length.

318.0 **Rodenkirchen** (highway)—Originally longest suspension bridge in Europe with a 1244 ft. main span. Completed just before the war it was wrecked from a chance bomb hit on one anchorage. Will not be rebuilt.

319.0 **Cologne-South** (railway) — Originally three tied arches of 333, 540 and 333 ft. spans. Back in service with one original 333 ft. span and a series of German SKR spans, one of 200 ft. and four of 150 ft.

320.0 **Cologne-Deutz** (highway) — Originally a self-anchored suspension bridge with a central span of 605 ft. and side spans of 302 ft. Being replaced with deck girder continuous cellular bridge on the old piers.

320.8 **Cologne-Hohenzollern** (railway and highway)—Originally three parallel bridges—two for railway, one for highway. Each consisted of three two-hinged tied arch spans, 390, 544, 402 ft. Highway only to be rebuilt.

322.0 **Cologne-Mulheim** (highway)—A 1033 ft. span, self-anchored suspension bridge. Not to be replaced.

351.0 **Dusseldorf-Neuss** (highway) — Originally a through cantilever bridge with a 676 ft. main span and 338 ft. anchor arms. Will not be rebuilt.

351.6 **Dusseldorf-Hamm** (railway) — Originally, two double track bridges of four 352-ft. spandrel-braced arches. One bridge back in service with two original spans and two German SKR military spans. Latter being replaced by two original arches from other bridge.

356.0 **Dusseldorf-Oberkassel** (highway) — Originally, two 595-ft. spandrel-braced-arch through spans similar to Bonn. Being replaced by four 300 ft. SKR spans.

368.0 **Krefeld** (highway)—Cantilever built to resemble a suspension bridge with an 825-ft. main span and 416-ft. side spans. Will be rebuilt in original form.

374.0 **Duisburg-Rheinhausen** (railway)—Originally two main truss spans of 620 and 413 ft. and two side truss spans of 341 ft. Divided-Warren bracing in side spans and divided-Warren bracing with subdivided bottom chord panels in main spans. No present plans for rebuilding.

374.6 **Duisburg-Hochfeld** (highway) — Originally two truss spans of 500 and 850 ft., double-Warren type. Scheduled for early replacement but not in original form.

378.0 **Duisburg-Homberg** (highway)—Originally largest cantilever bridge in Germany, contained five spans of 296, 405, 678, 427, and 279 ft. No plans for rebuilding.

381.0 **Baerl** (railway)—Consisted of three through truss spans of 350, 611 and 350 ft. Back in service.

399.0 **Wesel** (highway) — Long cantilever structure of normal type. No plans for replacement.

400.0 **Wesel** (railway) — Originally four parallel chord truss spans of 341 ft. each. To be replaced, but no plans.

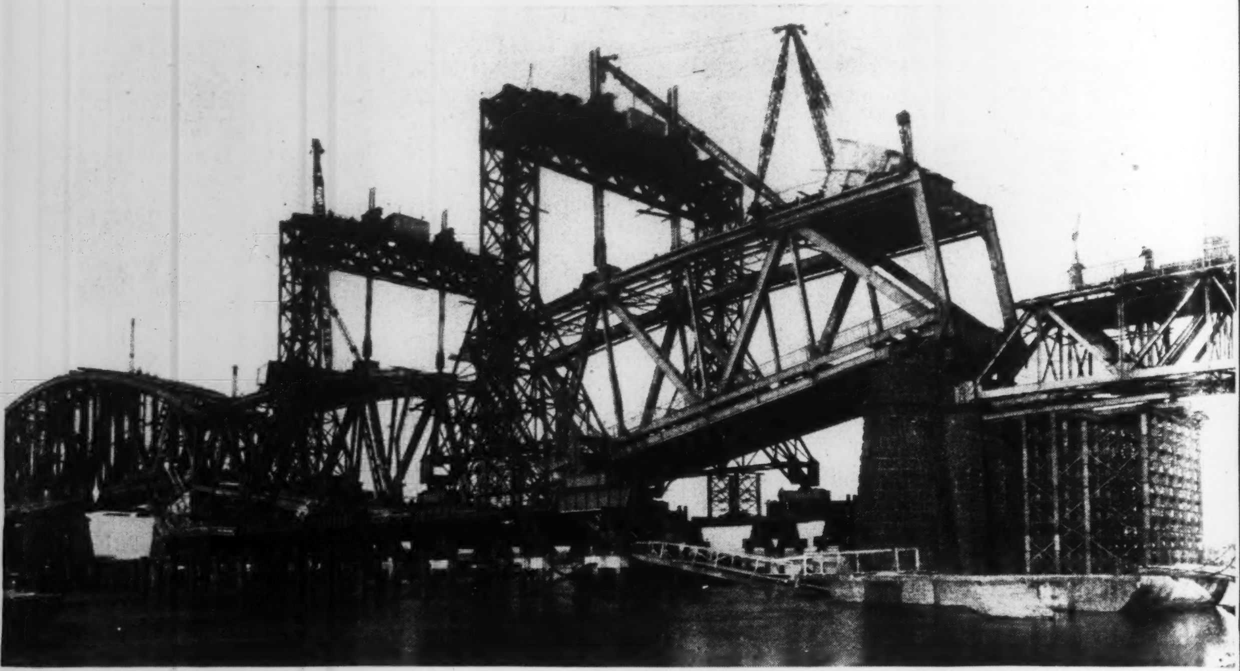


Fig. 9. Portal frames, each with 800-ton lifting capacity, salvage a 350-ft. span of the Baerl railway bridge in the Ruhr Frames can move longitudinally, while roller-mounted lifting carriages on top provide for transverse adjustments.

ing the truss depth to 26 ft. permitted the spans to be lengthened to 220 ft. For the shallower depth, a divided Warren web system was used, while the deeper truss utilized x-braced panels plus supplementary vertical and horizontal members in alternate panels.

RW trusses continued to be fabricated after World War I, at the same time that the German army began to improve their design. Higher strength steel (ST52, with a 50,000 psi yield point) was adopted, riveting was replaced by welding and some rolled members were superseded by pressed shapes. These changes resulted in the R type bridge developed by the Rheinhausen-Krupp works. These bridges utilized a divided-Warren web system in 13-ft. deep trusses, a K web system for trusses 26 ft. deep, and a Z web system for those 40 ft. deep. Maximum cantilever-erection span was 295 ft.

The next change was to prefabricate several different members into single units, such as chords with integral gussets, floorbeams with attached knee-braces, etc. This development, by the M.A.N. Co., resulted in the MZ and SZ bridges, the initials referring to the German words for "medium portable" and "heavy portable." The latter bridge in a K-braced web design 40 ft. deep could be used for spans up to 355 ft., erected by cantilevering.

These army bridges were developed between 1936 and 1944, but, as stated, they required very exact and special fabrication, and during World War II production bogged down. The SKR type, more adaptable to mass production and cheaper, was the result. Three types of SKR bridges (Fig. 12) were designed. The first for cantilever-erected spans up to about 200 ft. has a divided-Warren web system 20 ft. deep; for spans up to 400 ft., a K web system 40 ft. deep is used; and for spans up to 495 ft. a Z web system 60 ft. deep is required. No trusses with Z web systems have been used for the Rhine bridges.

The SKR bridges are 18 ft. wide and are designed for a load equivalent to Coopers E-45. Shop connections are riveted, field connections bolted. Some of the spans are of ordinary structural steel, others of ST52. Cantilever erection of the bridges is aided by a special crane that rides on the top chords. The SKR bridge members have also been used for foundation towers as well as for trusses in some of the bridges. Rhine bridges in which SKR trusses have been installed include Mannheim, Coblenz-Horchheim, Cologne-South and Dusseldorf-Hamm, all railroad crossings; and the Dusseldorf-Oberkassel highway bridge.

Erection and design expedients

Both in design and construction, the new Rhine bridges, existing and proposed, present a number of interesting and unusual aspects that are worth recording.

Cellular girders—Most significant of the new designs is that for the Cologne-Deutz crossing in the British Zone, where the wellknown self-anchored plate-chain suspension bridge will be replaced with a three-span continuous hollow-girder bridge on the old piers, Fig. 11 and 13. In addition to the cellular cross section, another design feature is the use of a relatively heavy roadway slab on the 302-ft. side spans in comparison to that on the 605-ft. center span. This side span loading, called prestressing by the Germans, greatly reduces the positive bending moments in the long center span, permitting a shallower depth and some saving in steel.

Originally the bridge will be built with a three-cell cross section, the longitudinal girders forming the side walls of x-braced boxes closed top and bottom with stiffened steel plates

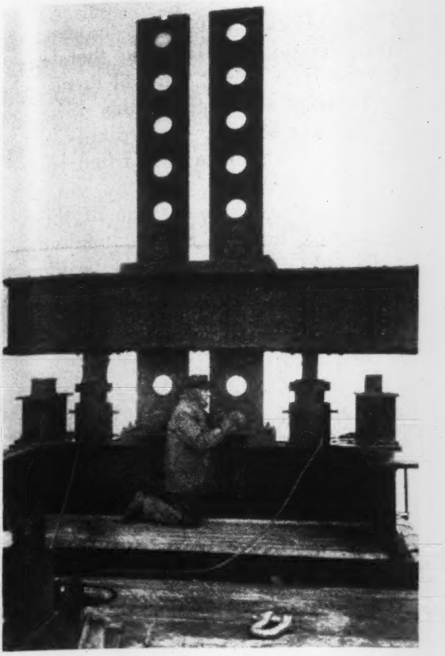


Fig. 10. Pinning off a lift atop Baerl portal frames. Note 200-ton jacks.

so that the whole assembly participates in carrying the load. Provision is made for later widening by the addition of another box at either side. Each box is about 13 ft. wide; the minimum depth is 10 ft., increasing to 25 ft. at the piers. The concrete slab roadway will be laid directly on the top plates of the boxes. It will be 37 ft. wide originally, and can later be widened to 59 ft.

A bridge of similar design, with a 615-ft. main span and 310-ft. side spans, is planned for Bonn, (Fig. 20) although an alternate proposed by one contractor, which has a through tied-arch main span and deck-arch side spans, is still under consideration on the claim that it could be built with 3,900 tons of steel as compared with 5,800 tons for the continuous cellular girder.

The Cologne-Deutz bridge is now under construction, using portal frame gantries similar to those utilized for lifting the wrecked span of the Baerl bridge described above. Two of these gantries are working out from either bank, running on falsework-supported tracks that extend out to the navigation channel. The part of the bridge over this channel will be set by a 100-ton floating crane. The estimated completion date for the bridge is June, 1948.

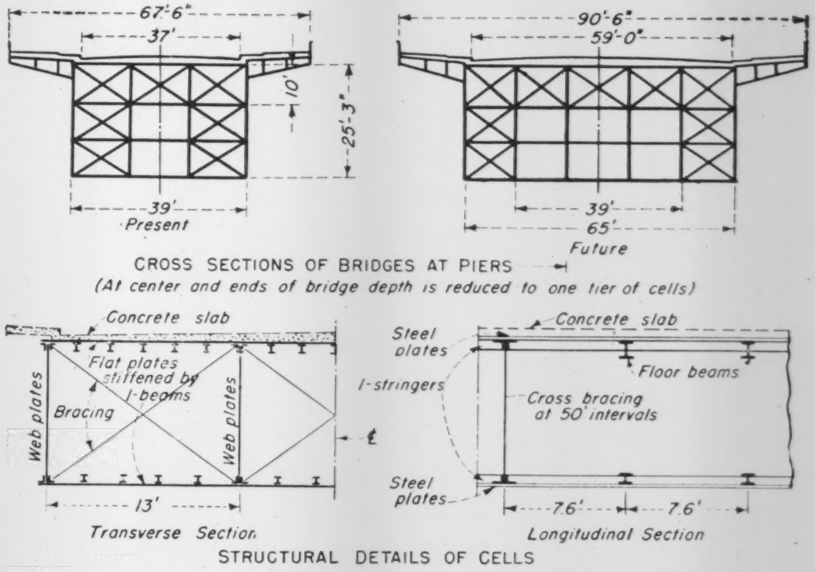

67'-6"
37'
10'
25'-3"
39'
Present
90'-6"
59'-0"
39'
65'
Future
CROSS SECTIONS OF BRIDGES AT PIERS
(At center and ends of bridge depth is reduced to one tier of cells)
Concrete slab
Flat plates stiffened by I-beams
Bracing
Web plates
Web plates
13'
Transverse Section
Steel plates
I-stringers
Steel plates
Concrete slab
Floor beams
Cross bracing at 50' intervals
℄
7.6'
7.6'
Longitudinal Section
STRUCTURAL DETAILS OF CELLS

Fig. 11. Structural details of a cellular girder bridge capable of being widened in the future, which is being built at the Cologne-Deutz site. Extra heavy pavement will be used on the side spans to reduce positive moments in the 605-ft. center span. A similar design is being studied for Bonn. See also Fig. 13.

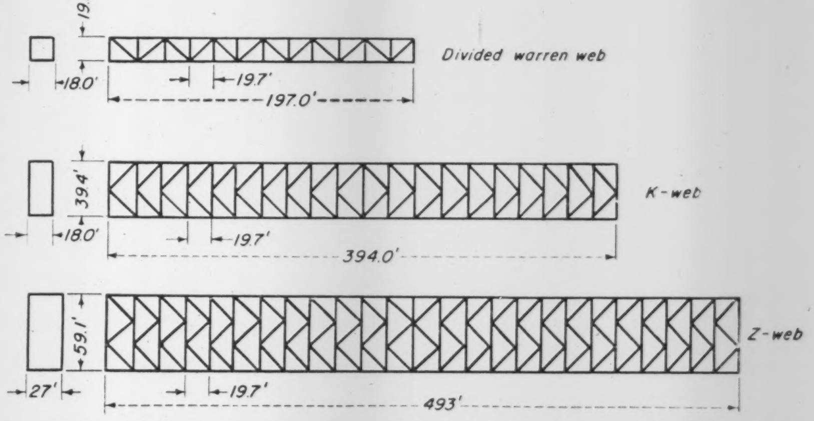

19.7'
18.0'
19.7'
197.0'
Divided warren web
39.4'
18.0'
19.7'
394.0'
K-web
59.1'
27'
19.7'
493'
Z-web

Fig. 12. SKR trusses, German military design for line-of-communication service, which are used extensivey in Rhine bridge rebuiding. Web arrangement and depth are varied to suit span.

Borrowed truss—An ingenious series of operations involving the three-span railroad bridges at Chalampe and Brisach has been engineered by the French. Both bridges were alike, but the Chalampe crossing was the more important. An intact 336-ft. Whipple truss span at Brisach was, therefore, borrowed and moved to Chalampe. Barges, on which tall falsework had been erected, (Fig. 5) picked the span off the Brisach piers in two halves which were then towed the 17 miles to Chalampe. The first half was transferred from the barge falsework to some falsework in place in the river on which it was slid shoreward to the abutment. The second half was connected to this first half while still resting on the barge falsework.

One of the other Chalampe spans was lifted from the river and the third was replaced by two Roth-Wagner truss spans, also recovered from a temporary German military bridge at Brisach. Heterogeneous though it is, the Chalampe bridge has been carrying rail traffic satisfactorily since early this year.

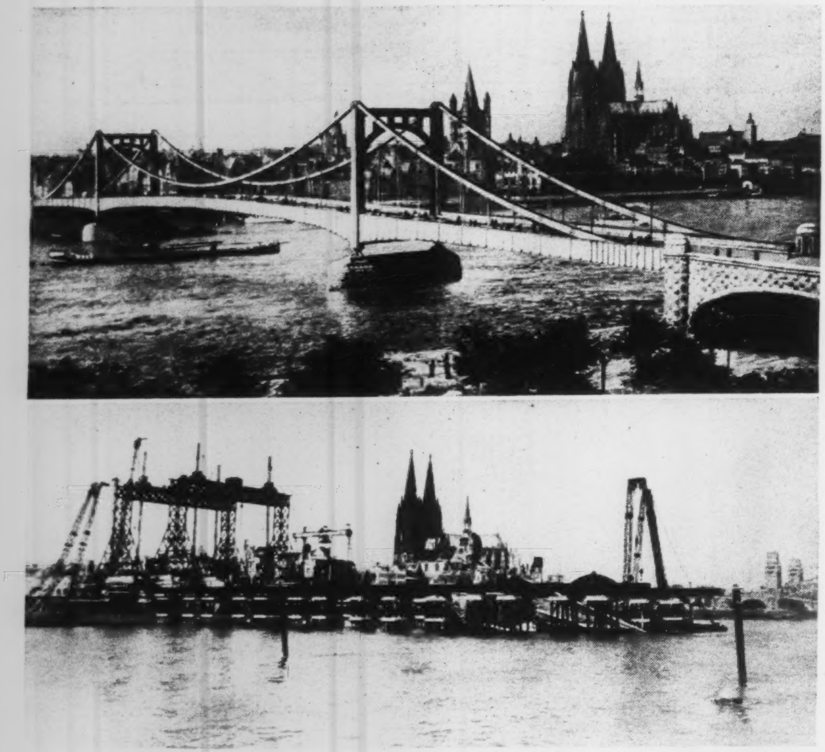


Fig. 13. Before-and-after at the Cologne-Deutz crossing of the Rhine. The famous self-anchored suspension bridge is being replaced by an equally interesting cellular girder design, for which falsework and portal type erection cranes are now being installed.

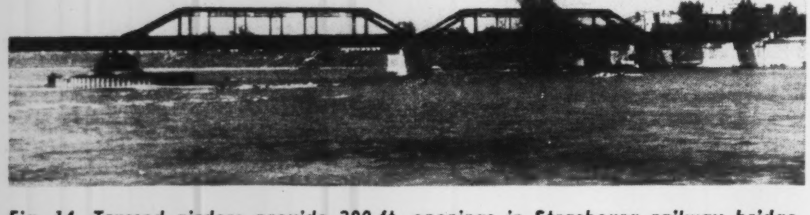


Fig. 14. Trussed girders provide 200-ft. openings in Strasbourg railway bridge. Same girders, without trussing, are used for shorter spans.

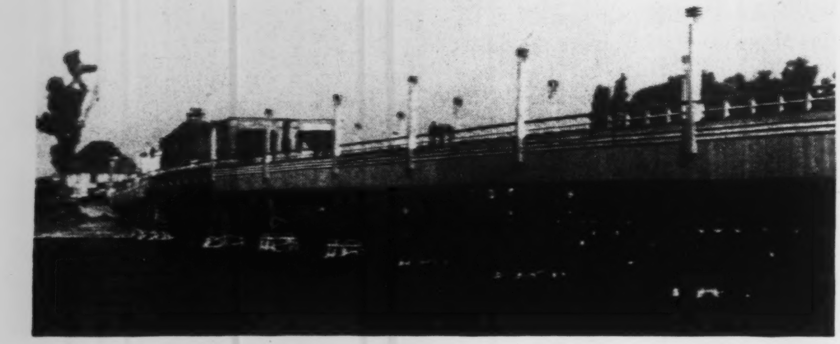


Fig. 15. French add a touch of architecture to Strasbourg laminated timber highway bridge by use of a modernistic fascia and lamp posts.

Railway to highway—In the meantime, decision was taken to abandon, for the time being, the rail crossing at Brisach and convert this bridge to highway service. Accordingly, the two side spans have been lifted back on their supports with the aid of timber portal frames. One of these spans will now be moved longitudinally into the central span position over the navigable channel, and its place taken by two or three shorter spans on piling piers. The wrecked land approach spans in this structure are being replaced with 75 ft. span fishbelly truss spans (Fig. 7) originally used in the floating causeways of the invasion harbors on the Normandy coast.

Laminated timber—The two replacement bridges at Strasbourg are unique among the new Rhine crossings, that for the highway being of timber while the railroad bridge is of special steel girder construction. Built by the French army engineers and the bridge department of the French province in which Strasbourg is located, the highway bridge consists of thirteen, 70-ft. timber girder spans with a 165-ft. through timber truss span across the navigation channel Fig. 15. In fact, there are two timber truss spans side by side, each with an 11 ft. roadway for one-way traffic. Elsewhere on the bridge the roadway is 22 ft. wide for two-way traffic and carried on 7 lines of 6½ ft. deep laminated girders. The truss members are also of laminated construction. Over a million feet board measure of lumber, 40 tons of nails and 15 tons of screws were required for the bridge. Modernistic lamp posts and railing integral with a continuous masking fascia of timber give an interesting appearance to this temporary bridge.

Trussed girders—The Strasbourg railway bridge consists of a series of plate girder spans all of the same depth, but with the two 200 ft. spans over the navigation channels (Fig. 14) strengthened by overhead truss framing. A normal French military bridge, known as the Bonnet-Schneider type, the spans were assembled on shore and launched into position. This particular bridge has a special history since it was fabricated secretly in France during the German occupation especially for this Strasbourg site in case the original bridge should be destroyed.

Standardized spans—At Maxau near Karlsruhe the French have completed parallel highway and railway bridges of five 200-ft. spans using a design developed in collaboration with a German contractor, which they plan to adopt as a standard (Fig. 16). A third bridge of this type is now under construction to replace the railway crossing at Worms, and one of the standard spans has been used in remodeling a temporary crossing at Coblenz.

The trusses of this French standard design are of divided Warren type and are similar to the SKR German military trusses from which the design was adapted. However, greater use is made of built-up members of channels and plates than in the military design, and pinned shoes are used at the ends of the spans to eliminate any horizontal forces in the foundations.

These foundations are an integral part of the standard bridge, and consist of a large number of steel pipe piles extending above water level and capped with a 6 ft. thick concrete slab on which rest structural steel bents that support the spans. The steel bents are anchored securely to these slabs at their bases and are pinned to the trusses at their tops. Each span is separately supported on the steel bents, but adjacent spans are tied together with pinned links in both the bottom and top chords.

Truss floated in—At Coblenz, the Pfaffendorf bridge commands interest both for what it was and for the methods used to provide a new crossing at this point. The original Pfaffendorf bridge, opened in 1864, was the best known of all the early wrought iron deck arch structures, (Fig. 17), and was widely copied at other locations in the subsequent two decades. Of three 320-ft. spans, it was the first braced arch with parallel curved chord ribs and lattice webbing.

When the Pfaffendorf bridge was wrecked by demolition charges in 1945 it was quickly replaced by a military structure of 100-ft. meter-beam spans and a 200-ft. Bailey truss span, all on high steel bents on pipe piles. One of the reasons for the fast construction was a rash promise made by a French administrative official that the bridge would be opened on Bastile Day, July 14, 1946. Stuck

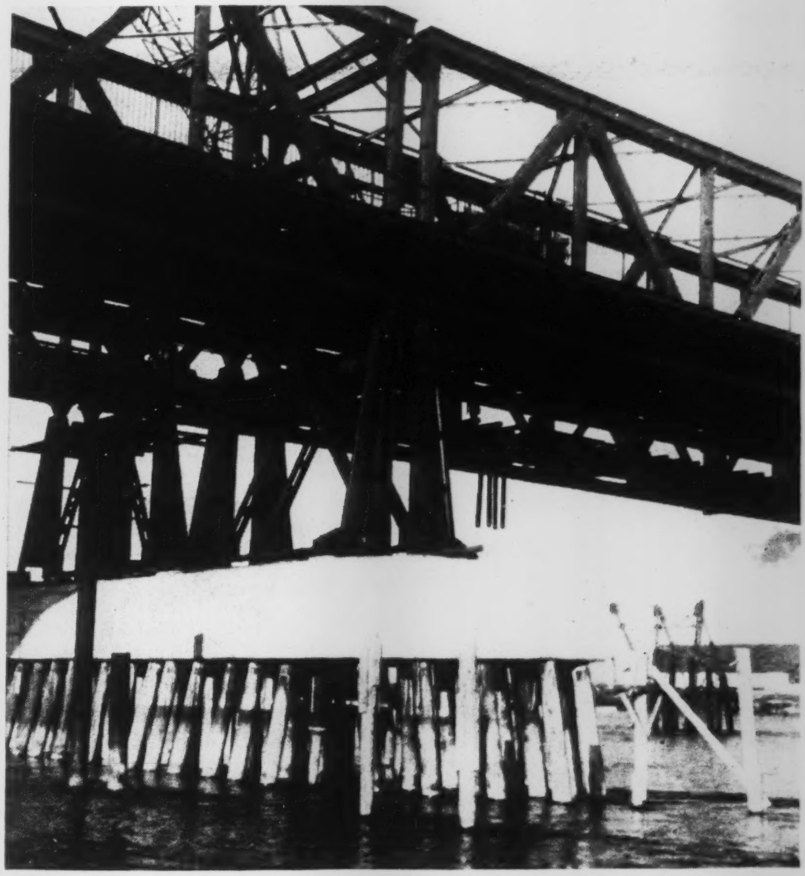


Fig. 16. Significant elements of a standard bridge developed by the French for the Rhine are simple, divided Warren trusses, pinned connections to supporting steel bents and foundations of pipe piles carrying a 6-ft. slab above normal water level. This one is at Maxau.

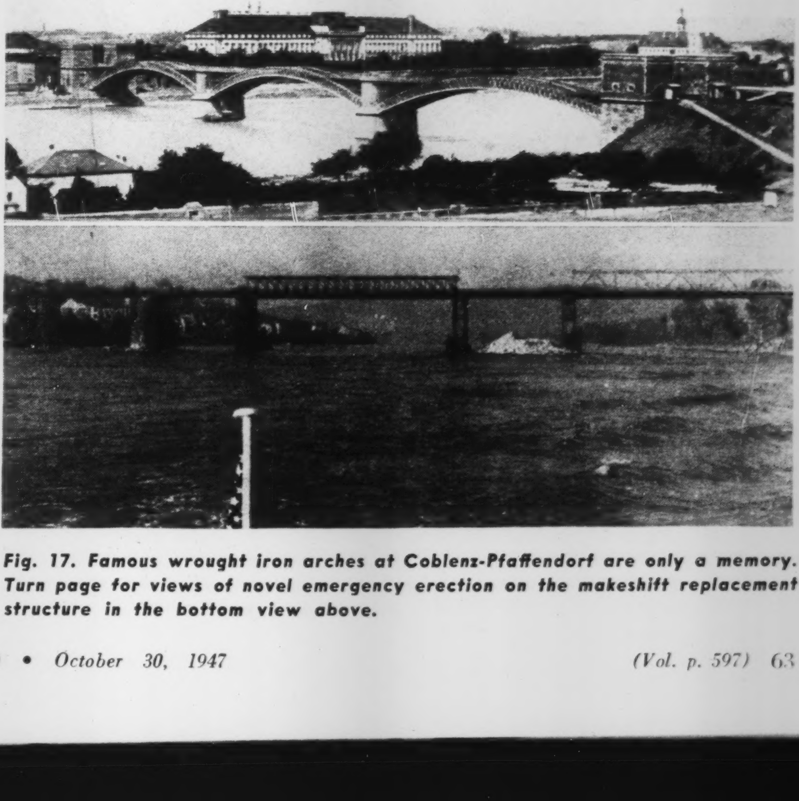
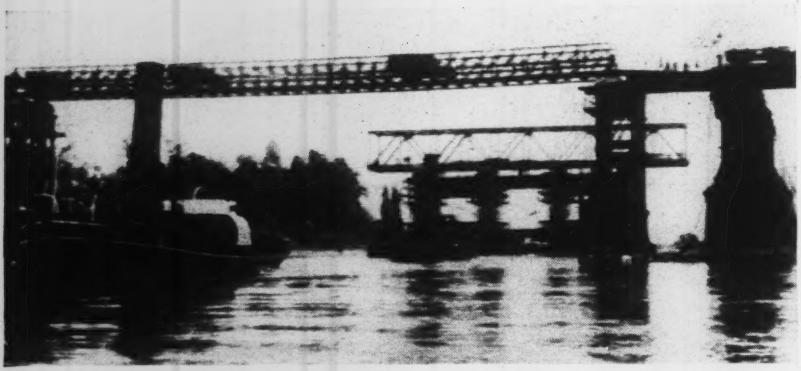
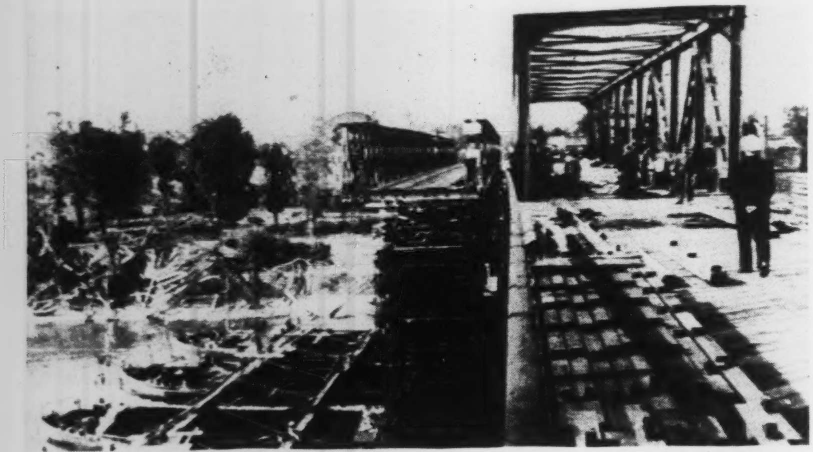


Fig. 17. Famous wrought iron arches at Coblenz-Pfaffendorf are only a memory. Turn page for views of novel emergency erection on the makeshift replacement structure in the bottom view above.

Fig. 18. NEW TRUSS IN, OLD TRUSS OUT AT PFAFFENDORF.



1. ***French standard truss on barges approaches Bailey span it will replace.***



2. ***Barges pick off Bailey span and land new truss in its place.***

3. ***Bailey span leaves Pfaffendorf for dismantling yard.***

with this publicly announced deadline, the French military government engineers appealed for help in the British and American zones and received the immediate loan of extra equipment and materials. The German contractor and the German workmen caught the spirit of the undertaking and worked 16 hours a day. The bridge was opened on time although in a form that soon proved to be inadequate.

Remodeling measures were then inaugurated. Locating an SKR truss of about 200 ft. span, this was erected on top of two of the 100 ft. meter-beam spans in the center of the river, which were then removed, providing a better navigable opening for the bridge than the one under the Bailey span.

Replacing the Bailey span was tackled next since it was too light for the increasing highway traffic, and the method used was spectacular and rapid (Fig. 18). On four Rhine barges lashed together to form a platform two sets of falsework of Bailey trussing were erected side by side. On top of one set a Maxau-type standard 200-ft. truss span was erected. The barges were then towed to the bridge site and anchored so that the Bailey span could be lowered onto the second set of falsework. When this transfer had been effected the barges were moved upstream a few feet farther until the new truss was on the bridge alignment, after which it was jacked up to supports on the steel bents. The barges with the Baily span were then taken to a yard for disassembly.

The present Pfaffendorf bridge is not a thing of beauty, but it provides two 200-ft. navigation openings and can probably handle highway traffic for a couple of years yet—unless floods or ice should take out one or more of its steel bent supports.

Long spans on one falsework bent—The other bridge at Coblenz, the railroad crossing to Horchheim, has also been replaced with some speed because of its importance to the French, the nearest rail bridges being at Coblenz and Mainz, each over 50 miles away. Reconstruction here was with two 350 ft. truss spans, fabricated by the Germans for some location in Russia. They were erected on the piers of the original bridge, using one falsework bent in the center of each opening. One span was built in place by cantilever methods. The other was assembled on the approaches, launched into position and lowered onto the supports.

Launching steel spans—At Dusseldorf, the Oberkassel bridge will soon present four 300-ft. SKR truss spans instead of its original two spandrel-braced through-arch spans of 595 ft. The new bridge is being built out from each approach by launching (Fig. 3). A temporary toggle truss erected over each unit supplies extra rigidity and furnishes a means of raising the temporary launching nose onto the piers if the sag of the cantilever ends proves to be excessive.

Long floating Bailey—The British are particularly anxious to complete the Oberkassel bridge so that they can retire the nearby floating Bailey bridge, which is periodically threatened by floods and ice. Known as the Freeman Bridge, in honor of Ralph Freeman, Jr., the Royal Engineer officer who built it, this floating Bailey is a remarkable temporary structure. Some 2,400 ft. long from end to end, about 1,000 ft. of the length is on barges, being carried on towers 20 to 25 ft. high also of Bailey bridging material. The floating section is made up of 80-ft. fixed spans that alternate with 24 ft. suspended spans. The navigation opening is a 150 ft. span also on barges. The whole floating bridge articulates, and special hinged connections are used between the floating and land sections to accommodate the construction to changing water levels in the river.

Design competition—As to bridges scheduled for early rebuilding in the British Zone, mention has already been made of the one at Bonn. Another with almost equal priority is the Duisberg-Hochfield highway crossing, and it has present interest as illustrating the procedure by which designs for the new bridges are selected. Three competent contractors were first asked to submit proposals. As shown in Fig. 19, each presented from two to five designs. Each design was accompanied by estimates showing the tonnage of old steel that could be reused and the tonnage of new steel required; also the number of months necessary for construction, the cost of foundations and the total cost. Using these data, officials of the British military government will choose one design, and recommend to the German authorities that the contract be let for it. Supplementary to the recommendation is a promise for priority on the new steel required. From that point on the job is up to the Germans. No decision has yet been reached on the type of bridge that will replace the original Duisburg-Hochfeld crossing.

Rhine trusses for the Ruhr—Two other bridges in the British zone, whose future is determined, although no definite construction priority has been set, are the Hohenzollern bridge at Cologne and the highway bridge at Krefeld. Both were famous structures before the war. The Hohenzollern bridge, consisting of two railroad bridges and a highway bridge on the same set of piers, carried the heaviest traffic of all Rhine bridges. The Krefeld bridge was a cantilever structure made to resemble a suspension bridge in appearance.

The three tied-arch spans of each of the Hohenzollern bridges were dropped into the river when the piers were blown by demolition charges. Wreckage of the 544 ft. center spans has been cleared away, but the side spans still slope into the river from each bank. The plan is to raise these side spans to the horizontal, and put two of them at each bank on barges for removal elsewhere. Of these four spans two, and perhaps three, will be floated down to Duisburg for installation over the Ruhr river where single span bridges are needed. The remaining span will be available for the center opening of a rebuilt Hohenzollern highway bridge at Cologne.

Original to be restored—A Krefeld, one anchor span and a cantilever arm remain standing and undamaged. Here the plan is to rebuild the opposite anchor span and cantilever arm on falsework and by balancing about the existing pier. The central suspended section can then be floated in to restore this bridge to its original form.

American Rhine bridges

Since the Rhine does not run through the American zone, but only along its western border, the U. S. military government has had a somewhat lesser bridging and river clearance task than has been the case in the French and British zones. Nevertheless, in the 100-mile reach from Karlsruhe to Rudesheim, there are three bridge jobs that are our responsibility, largely because we built military type temporary bridges at the sites. These are the highway bridge at Mannheim and the South railroad bridge and the Kastel highway bridge at Mainz.

The present American bridges at Mainz—the General Patch highway bridge and the General Marshall railway bridge—may be classed as semipermanent, while the Dunbar highway bridge at Mannheim is definitely a temporary type. As all, however, are inadequate and hazardous to navigation, the U. S. Military Government more than a year ago requested the U. S. Army Engineers to work with German contractors on prospective designs for medium-term bridges at these three sites. These designs have been worked out, but before de-

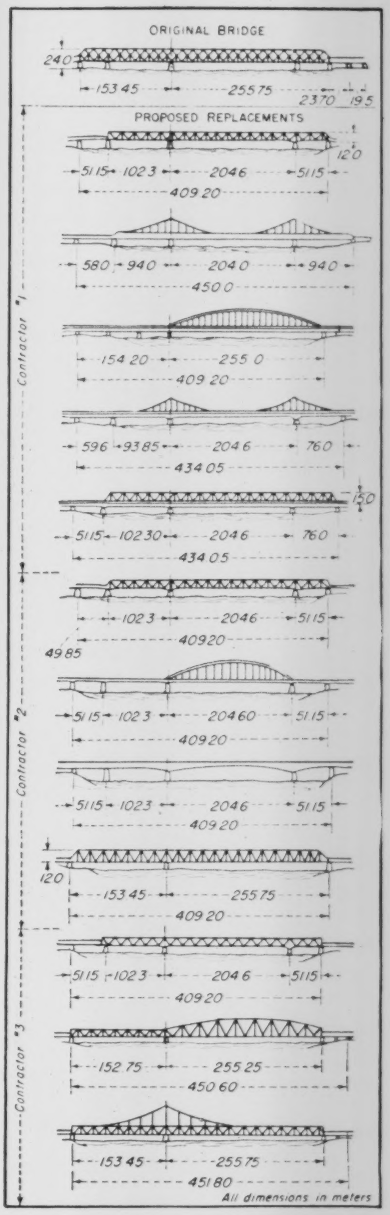


Fig. 19. Design competitions provide the ideas for the replacement bridges. These are the proposals submitted for the Duisburg-Hochfeld highway bridge in the Ruhr. Total cost and amount of new steel required weigh heavily in the final design selected.

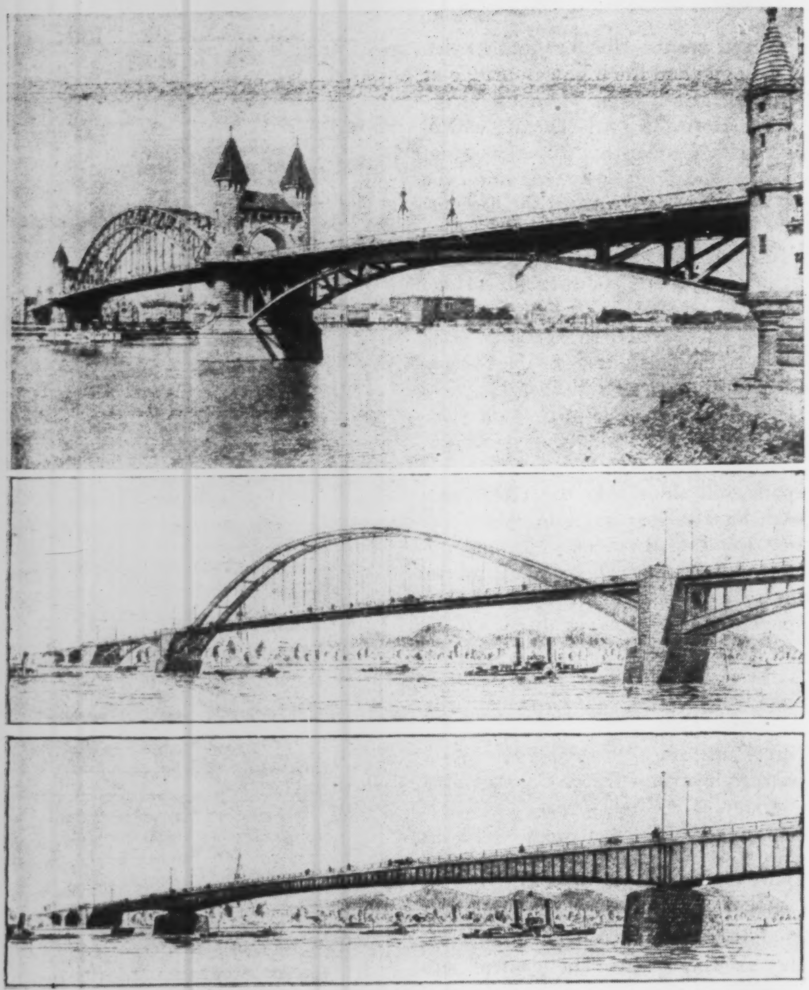


Fig. 20. Original Bonn highway bridge and two proposals for a permanent replacement structure. The cellular girder bridge is favored, but a substantial saving in steel, claimed for the arch design, is causing further study.

scribing them a few facts about the existing bridges are appropriate.

The Patch and Marshall bridges at Mainz are the latest and the best temporary crossings built over the Rhine. Started in August, 1945, both bridges were opened to traffic in January, 1946, as necessary key structures in the communication lines between the American occupation forces in Germany and their base and port installations then in France and Belgium.

Both bridges are of all-welded construction. The General Marshall single-track railway bridge, 3,163 ft. long, contains 42 meter-beam spans each 70 to 90 ft. in length, and a 178-ft. Roth-Wagner truss span that provides a clear navigation opening of 165 ft. horizontally and 29.3 ft. vertically above mean high water. Designed for Coopers E-45 loading, it carries a single track line. The majority of the land piers are founded on wood piles driven to a minimum safe bearing of 15 tons each, with penetrations running up to 65 ft.

The General Patch highway bridge is 1,972 ft. long, with 27 spans of meter beams and a 178-ft. Roth-Wagner truss span. Foundations are similar to the Marshall bridge. A 24-ft. roadway and two 2-ft. sidewalks are provided.

The Dunbar highway bridge at Mannheim (Fig. 1) is of similar although lighter construction than the ones at Mainz. The girder spans are shorter and the navigation span trusses provide only a 165 ft. opening. There is a vertical clearance of about 30 ft., which is some 10 ft. too low for the needs of prospective navigation. In addition, the span requires excessive maintenance to keep down pier scour.

The plan developed for replacing the Dunbar bridge involves the erection of three 299-ft. span trusses set on the existing piers of the old bridge some distance upstream. These piers, 135 ft. wide, already carry a new single track SKR railway bridge, and there is room for rebuilding the former double track railway bridge one span of which still leans against one of the piers and is salvageable. Although the trusses available for the proposed bridge were originally designed for railway spans, and are of a special type with divided Warren web system like the small SKR but 33 instead of 20 ft. deep, they would require only 524 tons of extra steel for lengthening each span 12 ft. and widening it 7 ft. The spans would be erected by setting several panels out from each support on falsework and cantilevering the rest of the way. Since the highway crossing at Mannheim is the only one between Karlsruhe and Mainz, it is held to be particularly important that it be made safe against floods and ice, which the Dunbar bridge is not.

Although the General Marshall and General Patch bridges provide navigation openings in excess of 150 ft. horizontally and 30 ft. vertically, it has been estimated that had they been in place from 1937 to 1940 they would have interfered with traffic to some extent during 290 days each year, and might have acted to reduce traffic by as much as 25 percent. Rhine traffic is now at a volume of about 13,000,000 tons annually, and it is estimated that if bottlenecks, including these bridges, could be eliminated, traffic may be expected to increase to 40,000,000 tons by 1948.

Plans for the Mainz-South railway bridge to replace the General Marshall bridge call for completely rebuilding the original river piers, which were designed and constructed in the 1860's for loadings now considered inadequate. Within the shelter of revetments built up from the debris of the old piers, the new piers would be sunk as pneumatic caissons to a depth of 43 ft. below mean water level.

A single track superstructure would be erected on these piers with provision for eventual doubletracking.

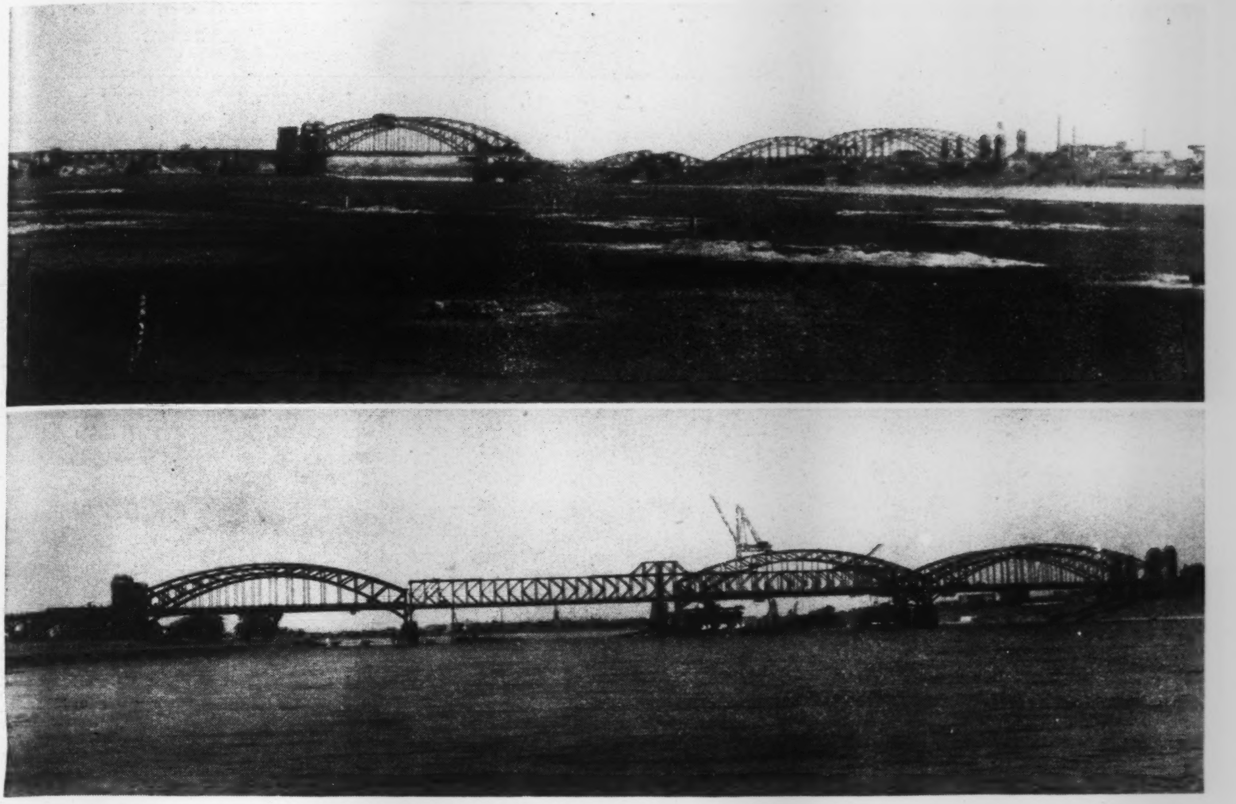


Fig. 21. Before-and-after views of the two parallel railway bridges at Dusseldorf-Hamm. Two arches in one bridge have been replaced by SKR spans. Current operation is to replace the SKR's by arches from the other bridge.

The land sections of the bridge could be built with salvage from the wrecked structure, but some 3,000 tons of new structural steel would be required for four 350 ft. continuous truss spans with parallel chords and divided Warren web systems for the river crossing. These would be erected by setting the first six panels of the west span on falsework and then cantilevering the remainder of the bridge, using one falsework bent just beyond the center of each of the other three spans.

Plans for the Mainz-Kastel highway bridge to replace the General Patch bridge call for rebuilding two wrecked piers from the water line and erecting three deck arches identical to the two spans still standing, which are of a type similar to those at Pfaffendorf (Fig. 17). To economize on steel, the initial width of the new construction will be only 33 ft. to provide a 20 ft. roadway and two 3½-ft. sidewalks. The new spans would be placed on the downstream half of the piers with the idea that the bridge later could be widened to 62 ft. The work would require 5,061 tons of new structural steel. The scheduled construction period for each of the Mainz bridges would be 16 months.

Erection method envisioned for the Kastel arches involves the use of a floating crane, with falsework bents at the third points of the spans. The rib sections would be set in three pieces by the floating cranes, after which a deck traveler could complete the construction.

The months ahead

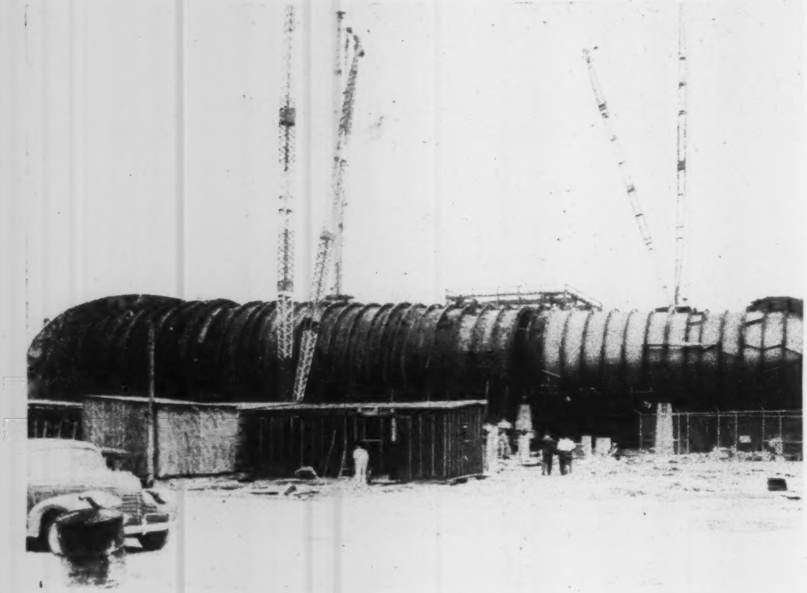
Late this summer permission was granted to go ahead with immediate replacement of the three American bridges at Mainz, and Mannheim and priorities for the necessary steel were set. Coming over a year and a half after the designs were completed this decision is indicative of the slow pace at which Rhine rehabilitation has had to move because of the shortage of steel.

Fortunately this same shortage and the complementary lack of coal production and industrial activity has kept Rhine traffic down to tonnages that can be handled on the restricted waterway. Likewise restrictions on highway and railway travel have worked to permit the makeshift bridges to provide reasonably adequate service.

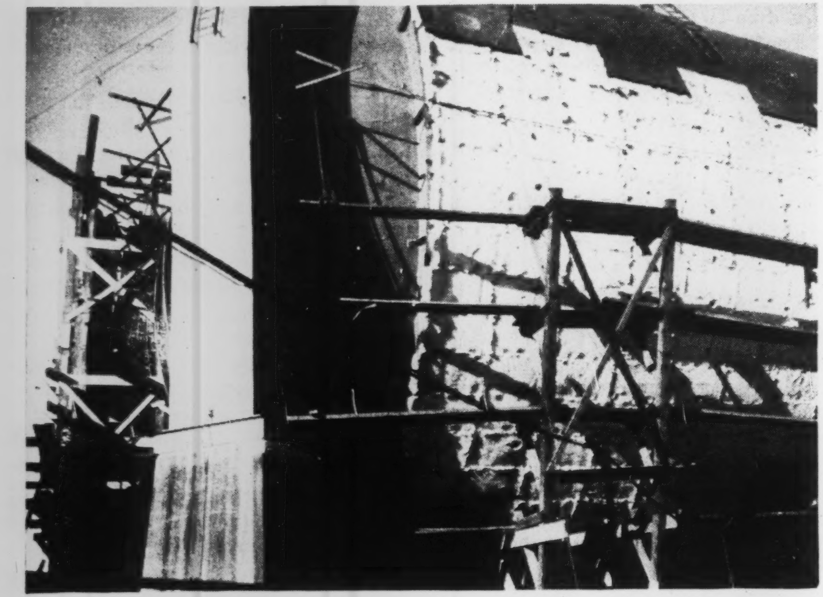
Once river traffic begins to increase, however, and highway and railway movements expand, a real pinch is apt to be felt. Preferably before then, greater efforts will need to be applied to Rhine clearance, barge renovation and bridge building. The months ahead will therefore be crucial, as military government officials attempt to allocate steel wisely among such equally important needs as Rhine rehabilitation, railroad and mine equipment, housing and industrial production generally. None can have all of the steel that would be desirable, of course, but Rhine requirements should not be slighted. If they are filled in even reasonable degree, the months ahead will witness great progress on Rhine bridging and river clearance, for know-how, equipment and competent personnel have been marshalled on the work that has already been accomplished.

Wind-Tunnel Heat Leakage Decreased Ninety Percent by Insulation

Use of mineral-wool insulation resulted in a 90 percent decrease in heat leakage into the steel shell of the altitude wind tunnel recently built for the Aircraft Engine Research Laboratories of the National Advisory Committee for Aeronautics in Cleveland, Ohio. This effected a considerable reduction in load on the refrigeration equipment, which was needed to remove heat generated by test engines and fan motors.



The inner shell of the wind tunnel at the Aircraft Engine Research Laboratories at Cleveland is of welded steel plates with steel stiffeners welded to them.



Flow of heat from the outside air to the interior of the tunnel during low-temperature testing is checked by mineral wool insulation secured to wire welded to the outer edges of the stiffeners shown in the upper view. The outer shell was assembled over the insulation.

Largest of its type in the world, the tunnel has a test area 20 ft. in diameter and can handle the biggest engines now in existence. Aircraft power plants can be tested under temperatures as low as —48 deg. F. and pressures equivalent to altitudes up to 50,000 ft.

The tunnel is formed by an inner or main shell, stiffening rings, mineral-wool insulation and an outer steel shell. Special arc-welding procedures were used on the shells to obtain maximum strength, freedom from leaks and a minimum resistance to air flow within the tunnel. Stiffening rings and supports were welded to the outer surface of the main shell. The thin external shell was fabricated on the site directly over the blanket of mineral-wool insulation.

Advantages of insulation

The advantage in insulating the tunnel is twofold: (1) The load on the refrigeration equipment is minimized by preventing atmospheric heat from permeating the tunnel and (2) test conditions can be more closely controlled. The mineral wool was placed in 2½-in. thick, 24 x 48-in. sections, utilizing the wire mesh that faces both sides of the blanket. Leaving an air space of 12 in. adjacent to the inner shell, the blankets were secured to heavy steel wires that had been welded to the stiffeners, and the meshes of adjacent sections were interlaced to form a continuous heat barrier.

Cendensation prevented

Since there is a large air space between the inner shell and the insulation, no vapor barrier was employed in this installation. Instead, an air breather system was developed to prevent undesirable moisture from forming on the outer surface of the inner shell. As temperature conditions within the tunnel vary, the air between the inner shell and the insulation expands and contracts. When the air expands, it is allowed to escape to the atmosphere, but when the volume contracts and new air is required to fill the void, this fresh air is supplied from a dehumidifying unit.

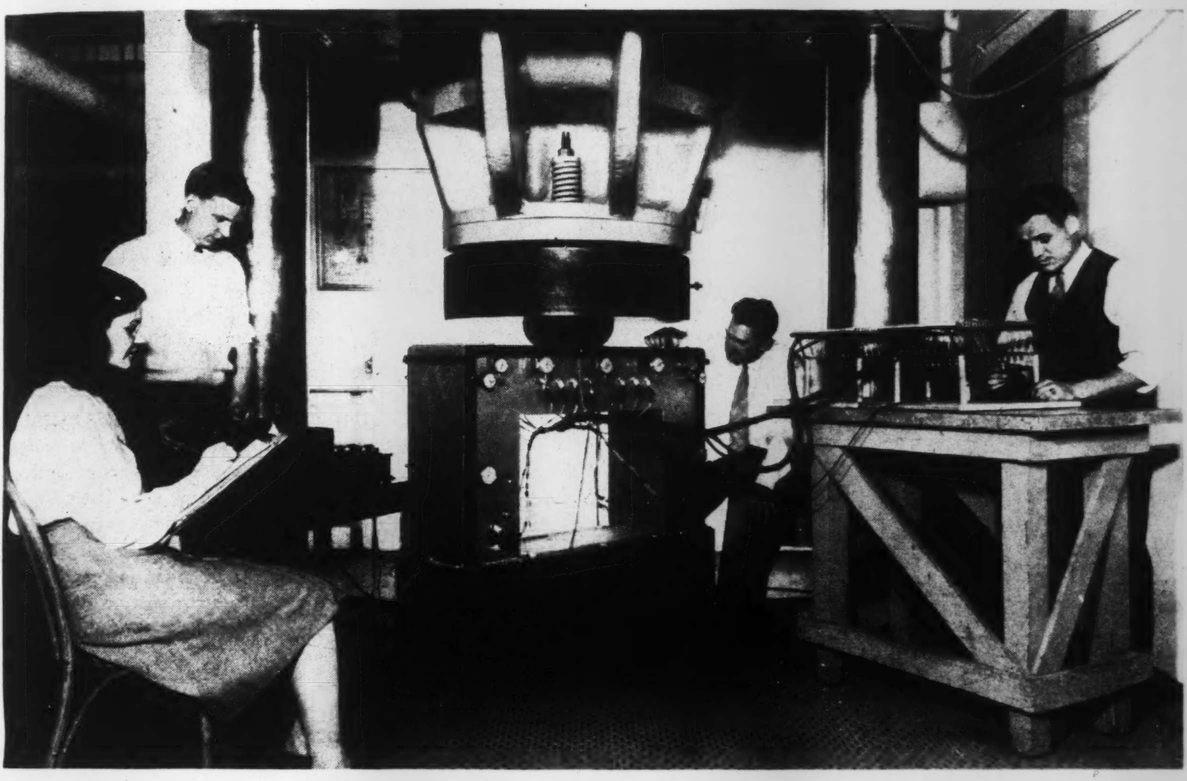


Fig. 1. With 185 electric strain gages embedded in this rigid frame model, full data will be revealed by testing to failure.

RESEARCH LABORATORIES OF THE RECLAMATION BUREAU—PART IV

Solving Office and Field Problems

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Head, Hydraulic Laboratory Section

Bureau of Reclamation, Denver, Colo

Contents in Brief—*In this fourth article on the activities of the Bureau of Reclamation laboratories, many examples are cited to show how facilities are coordinated in the solution of design and construction problems. Ingenious methods have been devised to provide answers to questions that heretofore defied explanation. Developments in electronic timers, for example, have made possible the detection of deterioration in concrete by measuring the speed of sound waves. Other special tests permit determination of true stresses in reinforcing steel, a quick measure of concrete permeability using a silver electroplating method, and the visualization of impact stresses by means of a cathode-ray oscillograph.*

THEORETICAL and practical developments in design and construction are subjected to critical analysis in the Bureau of Reclamation laboratories. This involves application of the skills and equipment of many branches of science, particularly those concerned with hydraulics, chemistry, geology, structures and materials. The functions of the laboratories in relation to the solution of these field and office problems fall into two broad classes: (1) those dealing with specific design and construction techniques; and (2) investigations of a fundamental nature leading to general improvement of engineering practice.

Any listing of design and construction matters currently under investigation would reveal a wide range of activities. For example:

Problems involving spillway operating characteristics, flow in open or closed conduits, hydraulic characteristics of valves, pumps and turbines, fall within the purview of the hydraulics laboratory, where they are studied either as part of a long-

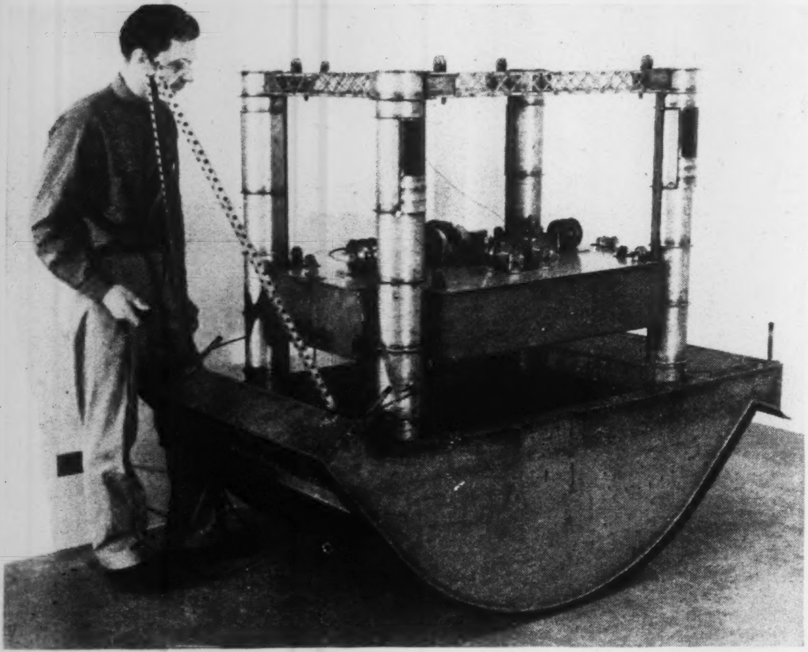


Fig. 2. A model of the bucket caisson for Grand Coulee Dam was completely equipped to perform stability and diving operations in a laboratory tank.

range research and development program or tested in a routine manner. Thus the problem of cavitation is being attacked from all angles, including theoretical studies, tests of various materials by the magnetostriction oscillator, and the development of protective coatings. But while these basic studies are under way many design problems of immediate urgency must be solved by the established methods of model testing.

Hydraulic model studies

Improvements in design accomplished by hydraulic model studies often result from the discovery of simple factors of performance, neglect of which might mean the difference between success or failure of operation.

For example, model tests showed that the original design for the outlets in Grand Coulee Dam would cause the issuing jet to impinge on the water surface downstream from the spillway, resulting in severe splash and erosion as well as bad scour conditions along the powerhouse tailraces. Also, a series of model tests of the outlet conduits revealed sub-atmospheric pressures in the model which, in the prototype, would have caused absolute vacuum throughout a considerable length of the conduits. Such a condition in the actual structure would have been disastrous due to the cavitation and consequent pitting.

It has been customary to design spillway overflow sections controlled by radial or slide gates in such a way that the overflow face coincides with the trajectory from the gate at a small opening. This criterion, established to prevent sub-atmospheric pressures, results in a very massive dam section in excess of that needed for stability. To investigate the feasibility of reducing this cross-section, a model was constructed of the Davis Dam spillway. The test proved that the negative pressures were not excessive, thus resulting in a substantial saving on this particular dam and the establishment of a more economical criterion for future designs.

The original design of the inlet structure for the 13-mi. Alva B. Adams transmountain diversion tunnel of the Colorado-Big Thompson project called for a straight crest divided into 20 bays opening into a double side-channel with the tunnel entrance at the center. Model tests showed that this design would not carry the proposed flow under the design conditions. Further investigation indicated that a circular crest with the 20 bays arranged in a fan-shaped pattern with the tunnel entrance at the center would produce uniform flow, reduce the cost about 55 per cent, and handle the discharge under the rigid specifications.

One phase of the Central Valley development is the Delta cross-channel to transfer Sacramento River water across the delta to the Delta-Mendota pumping plant. Two plans were considered to accomplish the transfer: (1) a new and separate channel skirting the delta, estimated to cost $35,000,000; and (2) a simple diversion from the Sacramento River into existing delta channels, estimated to cost $5,000,000. Because utilization of the natural channels might increase the intrusion of ocean salinity and contaminate the water enroute from the Sacramento River to the pumping plant, the savings represented by the difference in cost between the two plans could not be realized without definite proof that contamination would not occur. The necessary proof was supplied by an involved hydraulic model study which was directly responsible for the decision to use the natural channels.

In 1942 is was necessary to fill the reservoir behind Shasta Dam because construction progress permitted power generation sooner than previously planned. Two Stoney gates were designed for the diversion tunnel to regulate the flow of the river. These gates were in wells 165 ft. deep. Model tests showed that the hydraulic downpull force on each gate was in excess of the dead-weight of the gate, and was too great a force to be handled by the available hoist equipment. The tests indicated that if seals on the gate were placed on the upstream side instead of on the downstream, the downpull force could be completely eliminated and the structural design simplified, and that by changing the design of the transition in the tunnel from a horseshoe to a rectangular shape, the size of the gates could be reduced without affecting the flow conditions. Moreover, basic design principles were established that will permit of more economical construction of similar gates in the future.

Work for chemist and physicist

The chemists and physicists of the laboratory staff are engaged in investigations having to do with such recurring problems as the cause and remedy for occasional premature stiffening in fresh concrete; the testing or development of admixtures to meet specific needs; the cause of deterioration or abnormal volume changes in some concretes; examination of defective metal parts; and the prevention of corrosion by electrolysis or chemical attack.

Effect of swelling aggregates

Many concrete structures are now in distress because of a physicochemical effect which has been recognized only within the last few years —namely, the very slow swelling due to interaction between certain siliceous aggregates and alkalies contributed by the cement. The bureau laboratories have been among the active investigators of this phenomenon, which is one of the most important and puzzling problems which has developed in recent years in the field of concrete technology. The swelling appears to be caused by osmotic pressure which develops as a result of the formation of silica gels; and the preventative, when reactive aggregates must be used, appears to be in the use of cements low in alkalies or, possibly, in the use of pozzolanic materials to replace a part of this cement.

There has developed recently a growing recognition of the importance of swelling bentonite as a constituent in some foundations, and a research project is now under way to develop improved means of determining bentonite in clays. The methods which are being investigated include chemical, microscopic, X-ray diffraction, and differential thermal analysis.

A typical problem involving fundamental physics was presented by the construction forces in connection with the drilling of a large number of grout holes in a reinforced concrete tunnel lining. The drilling had been started, but it turned out to be unduly expensive because of the presence of the reinforcement. The laboratories designed an instrument for locating the steel bars so that they could be avoided by the drillers. This instrument, which will accurately locate a 1-in. bar at a depth of 12 in., operates by measuring the distortion of a magnetic field.

The field of electronics, with the great advances made as a result of war-time research, has become an important one in almost all phases of laboratory work. Electric strain gages, used with electronic amplifiers and recorders, have largely displaced the mechanical and optical gages. Electronic timers, accurate to a few millionths of a second, are used to detect deterioration in concrete by measuring the velocity of sound waves. Wave heights in hydraulic models are measured by noting the change in capacitance of an electrical system which requires no mechanical contact with the water surface. Impact stresses in concrete are translated into visual wave forms, which may be photographed, by the cathode-ray oscillograph.

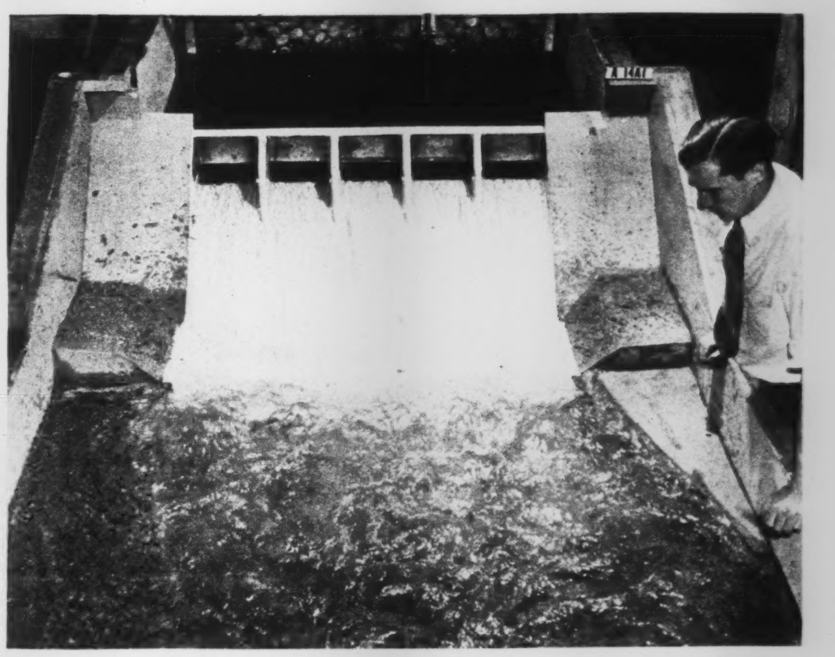


Fig. 3. Scale model of the Angostura spillway undergoing overflow tests. The test flow through the 1:72 model, photographed above, represents a discharge of 50,000 cfs. Designed total capacity of the spillway is 277,000 cfs.

Research on materials

Although the materials-testing unit is established primarily to determine the suitability of various materials for use in construction, this unit is engaged continually both in fundamental research and in the solution of current design and construction problems.

As a typical example, a problem connected with the pre-hydration of cement before mixing may be cited. Construction schemes proposed by contractors have frequently included arrangements in which cement and aggregate are batched together in a single bin or hopper prior to mixing. In the event of a prolonged delay between batching and mixing, the cement would then be partially hydrated due to contact with the damp aggregate.

This matter became particularly important in connection with plans for lining the Alva B. Adams tunnel, where the restricted working space in the 13-mi. long bore created a real problem in batching and mixing equipment. In order to assure that the quality of the concrete would not be affected adversely by the construction procedure, a working model of the batching plant was set up in the laboratory, and by use of this model means were worked out for minimizing the period of contact of the cement with the damp aggregate.

Tests also were made to determine the effect of partial prehydration on the quality of the concrete. For the particular moisture conditions investigated (7.5 percent moisture in the sand and 2 percent in the gravel) the strength loss amounted to 4.5 percent per hour of delay between batching and mixing. Delays up to 3 hours produced no significant differences in drying shrinkage, moisture loss, or absorption, while freezing and

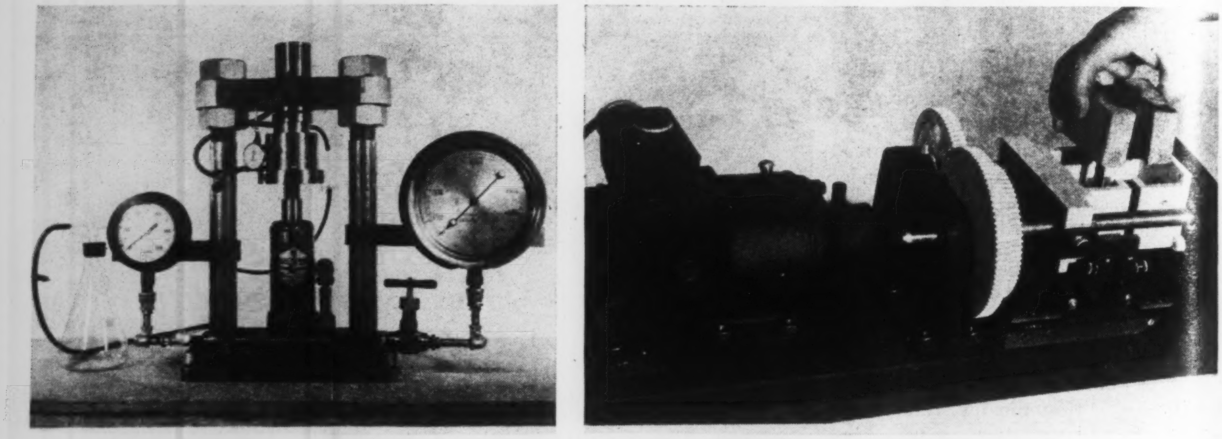


Fig. 4. Apparatus built in the laboratories to meet special needs includes: (right) joint-filler machine to test the bond and extensibility of the filler material; and (left) a hydraulic jack device for testing the swelling pressure of bentonite clays.

thawing durability was actually improved by the delay.

The measurement of permeability of concrete is a routine materials-laboratory test which is carried out for all major concrete structures. However, the standard permeability test involves a tedious procedure which is fraught with many possibilities of error. In a new test, which may be carried out in hours rather than weeks, permeability is determined by measuring the rate of passage of silver ions through the concrete. In essence, a slab of the concrete being tested is placed in an electroplating bath in such a way that it constitutes a barrier between the anode and the cathode, and therefore controls the rate of plating, all other factors being held constant. The test is still in the development stage.

Other problems in the materials field which are under more or less continuous study have to do with the methods of clean-up on concrete surfaces to assure good bond between successive lifts; improvements in foundation grouting practices; relationships between laboratory and field strength of concrete; improvements in batching and mixing equipment. Testing programs of earth materials are under way, or have been completed, on improved methods of consolidating embankments; the proper design of protective filters; and methods of backfilling around large pipes.

Special jobs for geologists

The major applications of geology have been covered in a previous article on site investigations; however, the wider scope of this scientific field, including petrography and mineralogy, is employed in a great variety of field and office problems.

The field geologist has been called upon to determine the cause of water-logging of certain lands, to devise remedial measures when structures have shown distress due to swelling ground, and to investigate the need for cathodic or other protection for steel piling.

The petrographers are engaged in studies of the pore structure of rocks in relation to their durability, the cause of early deterioration of some concretes, the nature of frost action in soils and rocks, and similar problems.

Structural testing procedures

The variety of structures built by the bureau is so great, many of them unusual in type, that the structural designer frequently encounters problems which are not amenable to solution by established or standardized methods.

The substructure of a powerhouse, for example, which is essentially a massive block of reinforced concrete pierced by openings of a variety of shapes and sizes, is so complex that an accurate determination of stresses by theoretical analysis is impossible. Uncertainty in regard to stress distribution naturally leads to over-conservatism in design, and many bureau structures are so costly that even minor improvements in design criteria may result in savings of thousands of dollars on a single structure. In some cases the solution of these problems may require extensive basic research conducted over a period of years, but often they can be solved by standard methods of experimental stress analysis which are in everyday use in the engineering laboratories.

Structural testing has played an important part in the bureau's design and construction work for many years. This type of research was initiated at the time when the trial-load method of analyzing arch dams was being developed. Model tests were used extensively to assist in the development and confirmation of this method of analysis, which has now become the standard method of analyzing arch dams in this country and, to a growing extent, throughout the world.

Structural models of Hoover Dam assisted materially in arriving at the final design, and a model of Grand Coulee Dam served to clarify and confirm analytical studies which had indicated the presence of undesirable twist effects in the original design. A second model, incorporating means for reducing the twist effect, showed that the problem had been solved satisfactorily.

Some tests quickly made

In some cases the laboratory problem is simply one of determining the maximum load-carrying capacity of a structural part; for example, a new type of concrete bridge pier was designed recently in the Canals Division of the bureau, but the theoretical analysis was not adequate to evaluate its bearing capacity and its true factor of safety. Simple laboratory tests

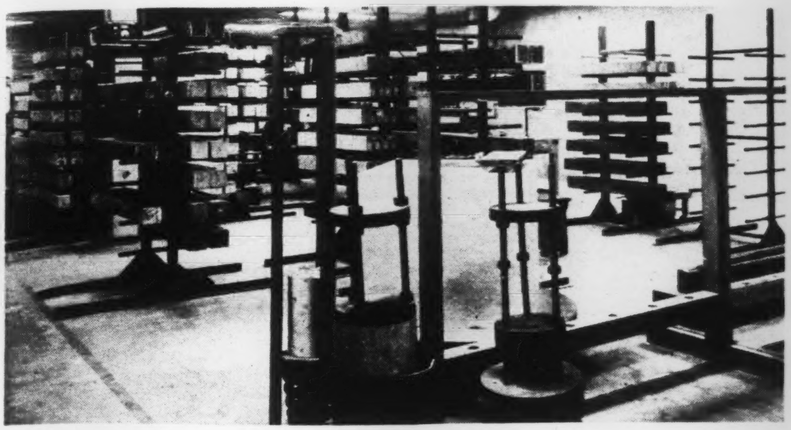


Fig. 5. Concrete specimens that are to be used for volume change determinations are stored in room maintained at 50 percent relative humidity and 70 deg.

in which small piers were subjected to loads up to 293,000 lb showed that the new design was entirely feasible and provided data on the actual load-carrying capacity. It is estimated that during the next few years this improved type of pier will be used for 180 small bridges.

In other cases, particularly those in which proposed alterations in design are being studied, a thorough investigation of stresses may be needed. The well-known photoelastic method is very useful in this respect, although several other methods have been developed as a result of recent advances in precise instrumentation

The laboratories were recently assigned the problem of investigating stresses in a large generator foundation. The prototype was a concrete structure about 50 ft. square of rather complex shape, and was to be subjected to a sudden torque loading due to short-circuiting of the generator. Stresses on all the surfaces of this structure were determined in the laboratory by the use of a small plastic model coated with a brittle lacquer which cracks readily under the action of a tensile stress. By applying the torque load to the model in successive increments and noting the gradual development of cracks in the lacquer, the stresses were evaluated in both magnitude and direction. This test also proved the feasibility of applying this simple method of analysis to a variety of complex structural problems.

The design of reinforced concrete structures, particularly such complicated structures as power plants, is a subject involving much uncertainty and considerable controversy. The bureau laboratories have developed and are using a method of measuring true stresses in the reinforcing steel of concrete structures or models so that many of the more controversial points can now be settled by direct measurement. The importance of this problem may be judged by the fact that during the year 1946 the bureau issued construction specifications calling for over $5,000,000 worth of reinforcing steel; and on some single large projects the cost of reinforcement may exceed $1,000,000. It is apparent that improvements in the use of reinforcement, even though they amount to only a small per centage of total costs may bring about substantial savings.

Tests have just been completed on a small reinforced concrete rigid frame which probably represent the most complete investigation which has been made on such a structure. This laboratory-size structure contained 185 electric strain gages attached to the reinforcing steel Several thousand measurements of steel stress were made for the various loading conditions which were applied.

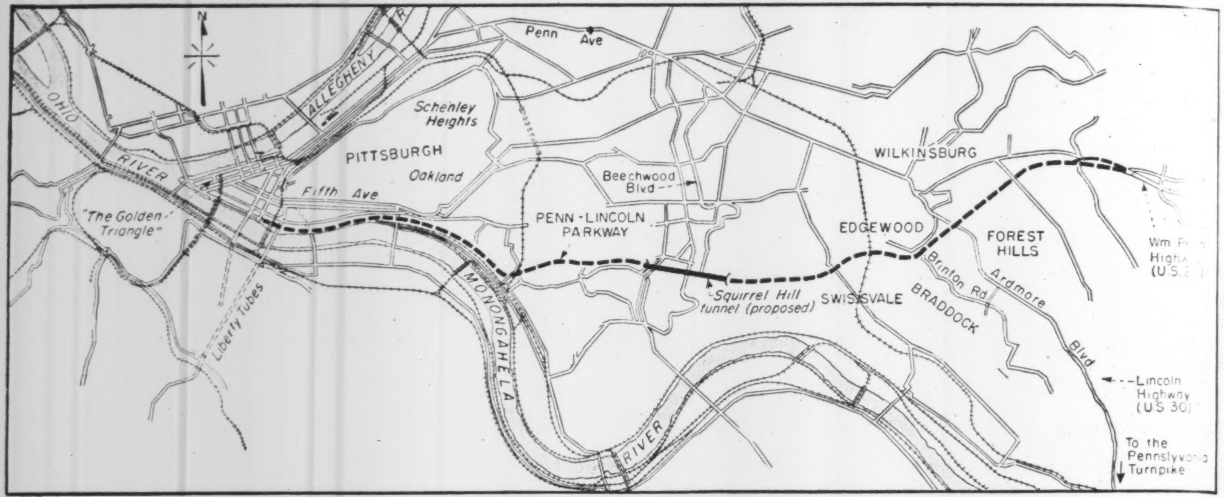
Improvements in design

Improvements in structural design are sometimes affected by empirical or cut-and-try methods, but more often they are brought about through a better understanding of the structural properties of materials or of the fundamental laws which govern the distribution of stresses in complex structures. The laboratories are engaged in continuous investigation of these basic aspects of design. The investigations are carried out through library research, extensive laboratory testing of materials and structural models or members, and through study of the behavior of structures in service. Although this type of research requires extensive specialized facilities, ranging from the microscope to high-capacity testing machines, its value derives primarily from the resourcefulness and ingenuity of the specialists who are assigned to the work.

It has been known for a number of years that the live-load carrying capacity of certain types of concrete structures is considerably greater than the capacity computed by standard design methods; and it has been assumed that this greater capacity results from a plastic yielding of the concrete under high compressive stresses. This is being investigated in the laboratory, and a special testing technique has been devised for observing the behavior of concrete in this so-called "plastic range." Although a large amount of experimentation is still needed, it is certain that this verification of the plastic theory will result in a better understanding of the behavior of concrete structures, and it will probably bring about more accurate and economical design methods.

Results checked in the field

Although the laboratories are used extensively for the solution of structural and hydraulic design problems, the limitations of laboratory tests are recognized, and it is found advisable to extend these testing techniques to structures in actual service. In this way, evaluation can be made of the effect of certain variables which cannot be included in the laboratory tests. It is frequently impossible to predict the exact forces to which a structure will be subjected, to anticipate the exact nature of foundation settlement or hydraulic behavior, or in the case of concrete, to foretell the exact amount of shrinkage or swelling which will occur. In such cases the true evaluation of design is reached by observations and measurements of or on the structure after it has been completed and put into service. How this is done will be told in an article to follow.



Completion of the 9½-mi., $40,000,000 Penn-Lincoln Parkway will provide four and six lanes of limited-access pavement for large volumes of traffic from Pennsylvania Turnpike, and William Penn and Lincoln highways, to downtown Pittsburgh.

Work Speeded on Penn-Lincoln Parkway

E. L. Schmidt,
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Harrisburg, Pa.

***Contents in Brief**—Construction is now underway on the much needed Penn-Lincoln Parkway to connect downtown Pittsburgh with the William Penn and Lincoln highways and the Pennsylvania Turnpike to the east. Major feature of the parkway is a long tunnel under Squirrel Hill.*

THE PENNSYLVANIA DEPARTMENT of Highways during the 1947 construction season expects to place under contract several additional units of the Penn-Lincoln Parkway in Pittsburgh. At present the department has projected 9½-mi. of limited access highway to accommodate the large volume of traffic using the Pennsylvania Turnpike, the William Penn and Lincoln highways, all three important east-west highways. Current contracts include the construction of nine bridges and 1.75 miles of four-lane pavement at the eastern end of the job.

To serve downtown Pittsburgh

The Penn-Lincoln Parkway is estimated to cost between $35,000,000 and $40,000,000. When completed, it will provide four traffic lanes from its eastern terminus to the west approach of the Squirrel Hill tunnel. From that point to downtown Pittsburgh it will accommodate six lanes of traffic. The downtown section of the project is still in the design stage

Six interchange points will be provided for the parkway, which will have a maximum grade of five percent, and a maximum horizontal curvature of four degrees. These features, together with the interchange designs eliminating opposing traffic, will permit motorists to negotiate the entire distance in ten minutes.

Many bridges needed

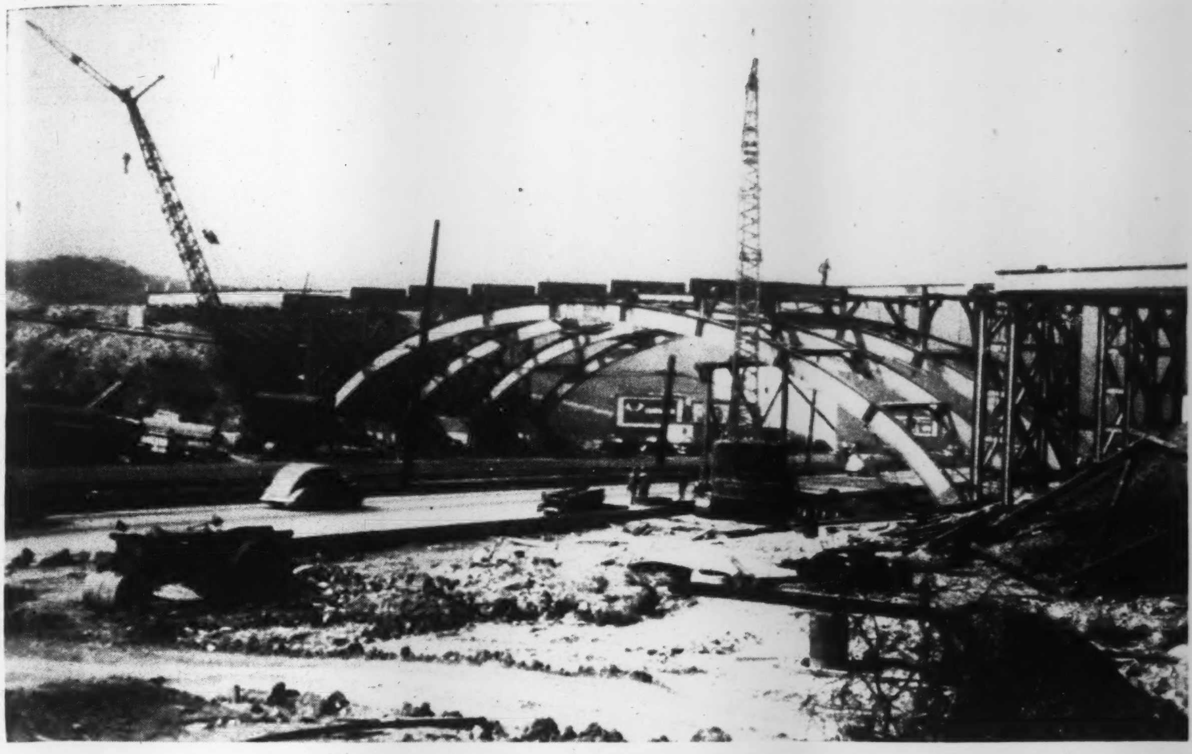
There will be 34 bridges in the 9½-mi. of parkway. They will be rigid frame, open-spandrel steel arch, continuous deck truss and plate girder designs. The divided roadway design will be maintained over these structures.

Perhaps the most expensive section of the project will be the twin-tube tunnel to carry the parkway under Squirrel Hill (*ENR*, Nov. 16, 1944, vol. p. 619). It will contain some innovations in design, most noteworthy of which will be the ventilating system.

The tunnel will be 4,225 ft. long. The tubes will be similar in design, each providing two 12-ft. lanes, with a constant grade of 2.5 percent falling from west to east. The traverse distance between the center lines of the tubes will be 60 ft. with a 30-ft. rock pillar support between adjacent walls of the tubes.

Tunnel overburden varies in depth, with a maximum of 250 ft. Except for the earth topping, it is composed of stratified shale, sandstone and limestone formations. For approximately 3,800 ft. each tube will be entirely in rock. In addition to the two 12-ft. traffc lanes each tube will have a 3-ft. sidewalk adjacent to the rock support between the tubes. Vertical clearance, between roadway and the ceiling slab, will be 14 ft. Above the ceiling each tube will have an air duct with a 6-ft. maximum height at the center for ventilating purposes.

The ventilating system designs for these tubes marks a distinct advance



A steel-arch bridge will carry the Penn-Lincoln Parkway over Route 30, which is the present connection between Pittsburgh and the Pennsylvania Turnpike for traffic to and from the East.

in vehicular tunnel ventilation in that most of the economies of longitudinal ventilation are retained without sacrificing the safety factor provided by the so-called transverse system developed originally for the Holland Tunnel in New York. In that system air is supplied continuously from a duct below the roadway and rises vertically to be drawn off through openings in the overhead duct.

In the first half of each tube, as a vehicle enters, fresh air is drawn in with the vehicle through the tunnel and vitiated air is drawn out through the overhead duct. The size of openings into the duct is adjusted to draw increased amounts of air from the tunnel as the distance from the portal increases. Beyond the midpoint in each tube, conditions are reversed. From the midpoint to the exit, fresh air is pumped into the tunnel through the overhead duct and the exhaust air flows out longitudinally through the tunnel to the exit. The latter arrangement is used in the seven tunnels on the Pennsylvania Turnpike. Special arrangements have been made to reverse the flow of air by tunnel guards in the event of fire.

The interior surfaces of the tunnel walls below the ceiling will be finished with a glazed structural facing designed to give the tunnel interior an attractive appearance and to increase the lighting by its reflecting qualities.

A de-aired brick pavement will be used in the tubes. The brick will be placed on a $\frac{3}{4}$-in. mastic cushion and separated by an asphaltic joint filler. At intervals of 500 ft. cross passageways will connect the two tunnels. They will serve as emergency outlets.

A contract was let recently for the construction of a bridge to carry the parkway under the main-line tracks of the Pennsylvania Railroad Co. and two existing streets in Edgewood Borough. John F. Casey Co., of Pittsburgh, Pa., submitted a low bid of $1,165,100. At that time a low bid of $314,000 by Sanctis Construction Inc., of Pittsburgh for the Brinton Road Bridge over the parkway was rejected, but on Sept. 12 a new bid by that firm of $302,311 was accepted.

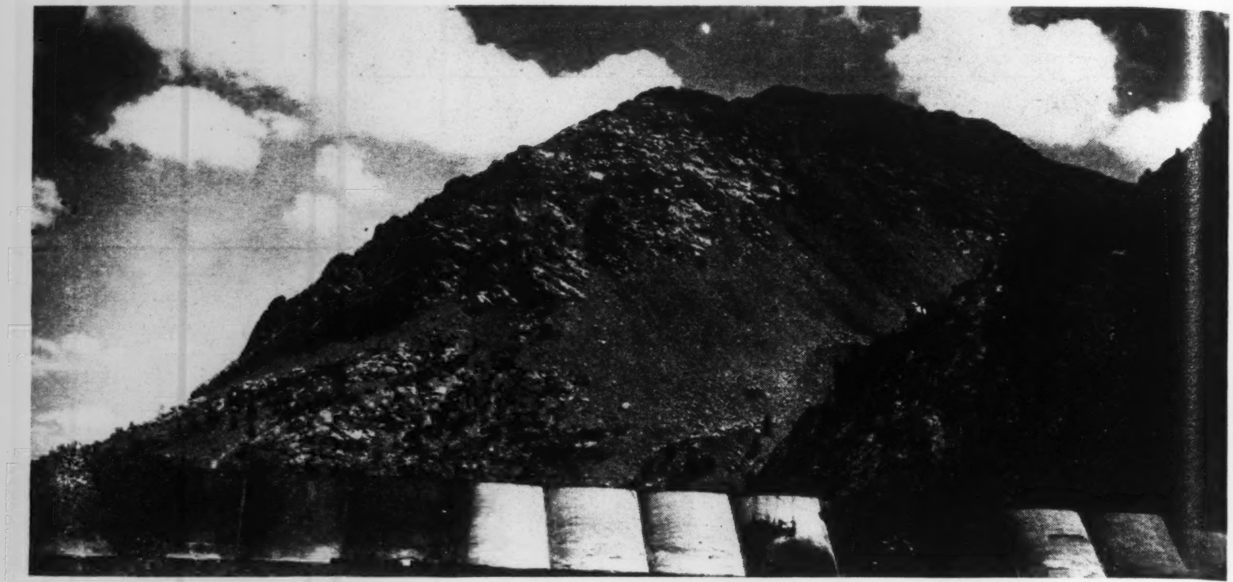
It is planned by the Pennsylvania Department of Highways to ask for bids late in November for construction of the tunnels and for the Commercial Ave. viaduct immediately east thereof.

Authority for this high-speed parkway was provided by the Pennsylvania General Assembly in May 1945, which authorized the Department of Highways to establish, construct and maintain limited-access highways.

Consulting engineers

Prior to the enactment of the necessary legislation the Pittsburgh district office of the department, under the author's personal direction, had been actively engaged since 1943, in the study, survey and design of this limited-access highway between Wilkinsburg and "The Golden Triangle" in downtown Pittsburgh.

Because of the wartime shortages of qualified personnel the then secretary of highways in December, 1943, signed a contract with Michael Baker, Jr., of Rochester, Pa., for completion of the plans. Mr. Baker in turn engaged George S. Richardson, of Pittsburgh, to design the bridges, and Ole Singstad, of New York, as consultant for the tunnel to carry the parkway under Squirrel Hill.



Gem Lake Dam has 16 arches of 40-ft. span. Temperatures at this altitude sometimes go as low as 25 deg. below zero.

Frost Protection for Concrete at El. 9,050

Contents in Brief—*Gem Lake Dam, a multiple arch structure in the High Sierra of California built 30 years ago and having trouble by reason of frost damage, has been given a coating of reinforced gunite on the upstream face of the upper position of the dam.*

A GUNITE COATING with a thickness of 2 to 3 in. has been applied to the upper 35,000 sq.ft. of a multiple-arch dam owned by the California Electric Power Co. located at El. 9,050 on Rush Creek in Mono County, Calif. The new coating is intended to decrease seepage which has been troublesome since construction of the dam in 1915-16. Prior to this treatment, some percolation continued in this upper section despite repeated attempts to make the structure tight plus annual maintenance during that part of the year when it has been possible to deliver materials to and work in the remote region where the dam is located.

A few years after the dam was completed it was found that deterioration had occurred in the concrete of the arches and that this was continuing progressively inward from the upstream face in a zone ranging from 10 ft. above the low point in the dam to approximately winter water level.

Explanation of this action was discovered when holes were made through the ice on the reservoir in the winter. Through these holes it was found that portions of the upstream surface of the arch barrels, below the level of reservoir ice, were coated with ice formed when the cold penetrated the thin arches enough to freeze water against the upstream face of the dam. Under such conditions moisture anywhere within the concrete of the arch barrels naturally would be frozen and damage to the concrete would result.

In 1924, nine years after the dam was built, additional concrete was deposited between the buttresses so that the arches were thickened to a gravity section up to a level 30 ft. below the crest. Since then there has been no concern about failure. However, percolation has continued and any moisture remaining in the concrete is detrimental, of course, if subjected to frost.

A description of this concrete deterioration was published in *ENR* July 2, 1925, vol. p. 22. While some engineers have blamed quality of materials used, it is generally admitted that a climate in which temperatures range so low would likely be an important factor in deterioration of concrete.

Original structure modified

The dam has a total crest length of 688 ft. which includes 16 full arches of 40-ft. span and two fractional arches. The maximum height is 84 ft.; thickness of the arch barrels range from 3.95 ft. in the lowest part of the structure and 1 ft. at the crest, both thicknesses being at the crown of the barrel arches.

The dam is located at the outlet of what was a natural lake, where it can develop storage for power development. Practically all of the tributary precipitation is in the form of winter snow which does not melt until warm weather. Hence during the winter there is little runoff and the power demand lowers the reservoir.

Shortly after completion of the dam, a single coat of unreinforced gunite was applied, ranging in thickness from $\frac{1}{4}$ in. at the crest to $\frac{3}{4}$ in. 80 ft. down the face. As this coating was not perfect, moisture got beneath it and when freezing occurred the coating was lifted from the original concrete surface. Thereafter the arch concrete itself was subjected to progressive deterioration resulting from alternate freezing and thawing of percolating moisture. When this reached a serious stage the arches were strengthened as noted.

Little damage has occurred in the upper levels of the arches. The original thin coat of gunite was still tightly bonded to the underlying concrete over considerable areas as late as 1945. However, the upstream surface of the dam has been watched closely and maintenance work has been done on it every year, repairing any areas that needed attention.

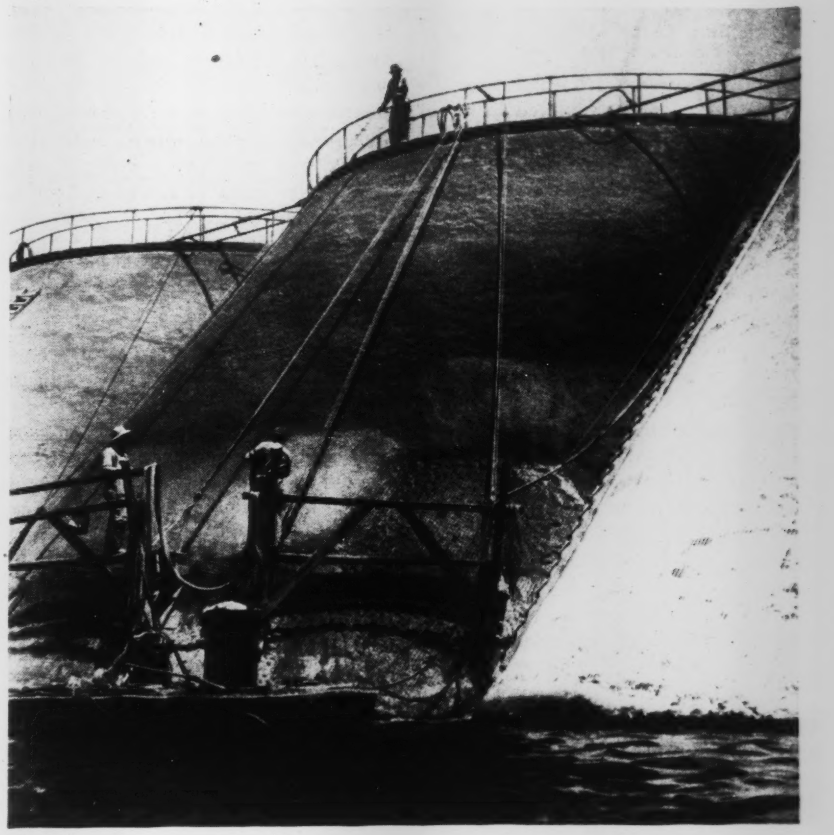
Each year, late in May and June, it has been the custom to go over all of the upstream face accessible above the rising water level, cutting out damaged areas and replacing the concrete and always coating the surface with some bituminous preparation. Several such preparations have been tried and it is believed that all were about equally successful in reducing leakage. However, none of them was a permanent cure for percolation and in recent years treatment of the accessible surface area has been merely two or three coats of asphalt emulsion applied by spray gun.

The 1945 gunite coating

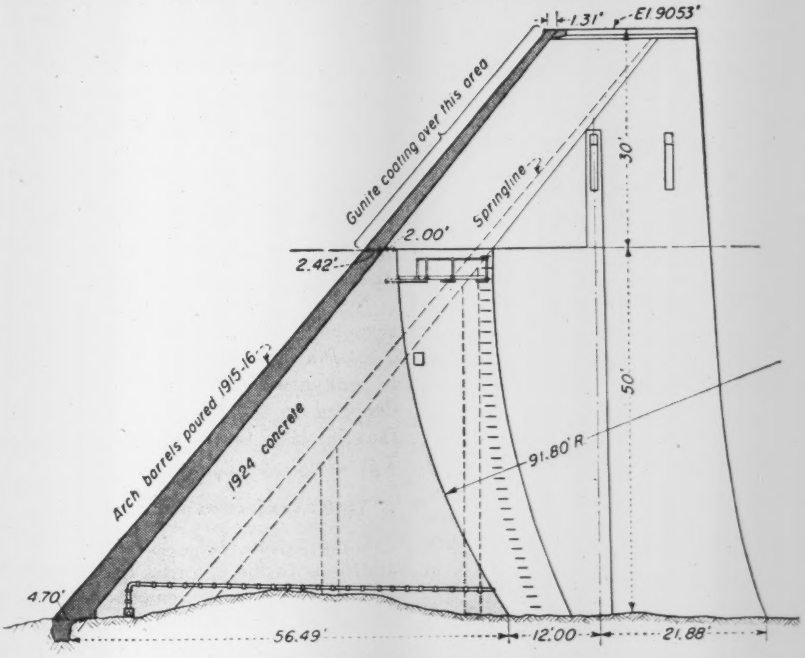
In 1945 it was decided to apply a reinforced coating of gunite to the entire surface of the upper 32 ft. of the arches and, depending on results that might be obtained in this work, probably continuing this treatment later to a lower level.

To make sure of a tight bond with the original concrete it was decided to remove remnants of the earlier gunite, any loose patching, all of the bituminous coatings and then to thoroughly roughen the concrete surface.

Since the season during which no night freezing occurs is quite short, the work of chipping off the face started late in the preceding fall and was completed on about half the area to be gunited before bad weather drove the workers to lower levels. Not until July 9 of the following season did weather conditions permit



Scaffolds slung from the crest and barges at reservoir level were used in applying a gunite coating on the upstream face. Barrel on the barge contains curing compound to be sprayed immediately over finished gunite.



TYPICAL SECTION, GEM LAKE DAM

After damage to the concrete had occurred below winter reservoir level, the lower parts of the thin arch barrels were thickened in 1925 to gravity section by additional concrete.

the resumption of chipping and roughening of the surface. Placing of gunite began on July 22 and continued for 20 days, by which time the area covered had amounted to about 35,000 sq.ft.

The reinforcing used in this coating consists of 2-in. square mesh of twelve-gage galvanized steel wire held in the center of the gunite with a minimum distance of 1 in. from the finished surface.

Gun operators and helpers worked on scaffolds supported at either end by block and tackle attached to railing posts at the crest. Usually, three scaffolds were used on an arch barrel, the two-man crew moving from one to another as this was convenient. The arches stand at an angle of 40 deg. from the vertical, and hence the scaffolds could be raised and lowered quite readily by the workmen themselves. When the work approached water level, barges were substituted for the scaffolds.

In preparation for the guniting the surface was first chipped with air hammers to an average depth of about 1 in. then thoroughly washed down with an air-water jet.

The next step was the laying, lapping and tying of reinforcing mesh.

The mix used was 4½ parts graded sand to 1 of cement and the rebound was wasted. Just before applying the gunite the area to be covered was thoroughly wetted down. After the facing was in place a curing compound was used to retain the moisture in the mix.

Facing thus far successful

After the 1945 coating was completed, and before the winter drawdown began, the reservoir level rose enough to submerge a 16-ft. width of the newly placed gunite coating. Any moisture that penetrated the surface coat and remained trapped between the old concrete and the gunite would tend to lift the gunite if freezing occurred. During the following summer (1946) this zone was carefully examined by tapping to see whether any loose areas could be found. These tests are reported to have shown that all of the gunite was tightly bonded.

Late in 1946 the reservoir level reached an elevation 23 ft. up on the new work, 4 ft. below the spillway and 9 ft. below the crest of the dam, thus subjecting still more of the new coating to an immersion test. During this highest water level small moist areas showed at the rear of three of the arches and damp spots appeared on three buttresses. Otherwise all concrete back of the submerged gunite coating appeared to remain dry.

Little deterioration is expected by power company officials in the gunite itself. The real test will be whether the gunite will remain tightly bonded to the concrete or whether small leakage of moisture through the surface coat will lift portions of the gunite when winter freezing occurs. Power company officials point out that not until the gunite has gone through a few more winters will it be possible to rate accurately its ability to resist this form of frost action. At the end of the 1946 season the power company management reported the gunite coating work "appeared to be very good though not quite perfect."

Placement of the gunite coating was done under contract by Emsco of San Francisco, under the general supervision of J. H. Darling. E. J. Waugh is construction engineer for the California Electric Power Co. and E. I. Bulpitt was in charge for the power company at the dam.

Traffic Congestion Increases

There are now more cars on the road than there were at the 1941 peak and they are contributing to the biggest traffic jams in history.

The American Society of Planning Officials, commenting on plans by major cities to ease traffic congestion, reports that almost 2.6 million cars and trucks have been produced this year while considerably fewer old ones have been junked.

At Pearl Harbor time, 34,472,145 cars and trucks were licensed according to the Automotive Safety Foundation. At the end of 1946, 33,945,817 vehicles were licensed, to which has been added the bigger part of this year's auto production. Since the bulk of the demand for new cars is still unmet, traffic tangles are expected to get worse before they get better.

Removal of auto travel curbs has increased traffic congestion even more. Present traffic in Milwaukee is 92 percent greater than during the war, while New York, Chicago and other cities report increases of 50 percent or more. Indicating how great the nationwide traffic increases have been, motor vehicles last year consumed 1,457 billion more gallons of gasoline than in 1941.

Not nearly as many cars are being scrapped as before the war. In 1940, 2,350,000 autos ended their service in junkyards. By 1943 that figure had dropped to 920,000. It is estimated that the 1947 total will be only about 1 million.

Traffic congestion and masterplans

Washington, D. C., is among latest additions to the growing list of cities making traffic improvements a central part of long-range development plans. Plans for reducing traffic congestion are basic to masterplans newly drafted or nearing completion in Newark, Pittsburgh, Detroit, Cincinnati, Providence, San Francisco, New York, Chicago and other major cities.

Parking is the big problem. Washington's proposed parking program calls for creation of new offstreet parking facilities to care for both short-time parking and all-day parking in congested areas. Typical of plans in other cities, the program calls for fringe parking lots in the outskirts of business districts to reduce traffic congestion on busy overloaded streets.

Some cities are limiting special parking privileges to ease congestion. In downtown Richmond, Va., spaces reserved at the curb for various organizations and individuals are being opened to vehicles driven by the general public. Officials expect an 800 percent increase in the number of vehicles these spaces accommodate once they are returned to public one-hour use.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Competitive Engineering Bids

Sir: Reference is made to your editorials and certain readers' discussions of "Competitive Engineering Proposals", which have appeared in recent issues of your publication (*ENR* Sept. 4, vol. p. 311).

The following considerations are stated in an effort to reconcile opposing opinions which have appeared.

Discussion seems to divide into two parts, (1) ethical considerations, and (2) economic considerations. The most severe criticism of current practices results when there occurs apparent under-cutting of schedules of minimum fees established in codes of practice. The easiest reconciliation of opposing opinions is effected when competition occurs on a plane somewhat above the minimum-fee level.

Engineers are a part of the business world, associated particularly with the construction industry. Obtaining engagements for engineering work is a competitive business with some features associated in the public mind identical to the securing of construction service by letting a contract to the lowest bidder. Obtaining an engagement for engineering work is a business proposition, requiring a business approach, and will undoubtedly meet with business treatment from both public and private employers.

The prospective employer often introduces the competitive element as a matter of business policy by interviewing several engineers for the same job. A public contracting agency may call for bids in the belief that (1) such procedure protects the public interest for which it is responsible, and (2) it is legally mandatory. Since the business procedure has approved legal status it should be possible for engineers to adopt an equally realistic procedure to obtain their legitimate share of available business without sacrifice of professional status.

Apparent undercutting of scheduled minimum fees is not always a fact. A public contracting agency which has an engineering organization qualified to handle work up to a certain point, may desire from an outside engineer only part of the service listed in a certain scheduled category. In good faith, on the basis of information received, the engineer may agree to a reasonable discount from his usual fee for full services in that category. The complete circumstances of an agreement are not certainly known to one not a party thereto.

With respect to ethical considerations, the following is quoted from the preamble to the code of practice adopted by ASCE:

> Any code of ethics is founded on the Golden Rule. A code of practice is an application of a code of ethics.
>
> This is a code of practice. It is intended as a statement of conduct which is correct under most conditions. Cases may arise in which almost any article of the code should not be applied rigidly, if at all. It is therefore intended not as a code of laws, but as a set of statements so generally true that there is a burden upon the engineer to observe them, except when he shall satisfy himself that in his particular situation the statement made does not apply.
>
> Its purpose is not so much to impose on any one the judgment of others as to set each one thinking and forming his own judgment. Every member of a profession is, or should be, constantly revising and enlarging his conception of the conduct proper to that profession, and to this essential process of becoming his own judge, a code of practice is a great aid. It calls attention to practical applications of the code of ethics which might not be in the minds of some members, especially those of less experience.

A reasonable amount of tolerance as indicated in the above quotation is worthy of application in the relations of engineers to each other and to business conditions generally.

Strict observance of ethical considerations is easy if economic circumstances are easy. Unfortunately, economic circumstances fluctuate. In the last analysis individual standards of integrity and social responsibility determine an engineer's professional and business status on the basis of fundamentals, such as—

(a) Acting in good faith by his job.

(b) Meeting his obligations and paying his bills promptly.

From the business point of view, engineers along with the general public are rated by credit agencies on the basis of (1) prompt pay, (2) slow pay, and (3) bad pay.

Certainly engineers should have connection with none but legitimate enterprises. Experience teaches that neither people nor business conditions are pure white or pure black—most are various shades of gray. Good judgment, which is supposed to be part of the equipment of the competent engineer, must be relied upon to distinguish between application of reasonable tolerance and submission to exploitation.

A. H. DAVIDSON,
Consulting Engineer
Glens Falls, N. Y.

Architects and Engineers

Sir: The item "Architects Win Empty Victory" in the Sept. 18 issue of *ENR*, vol. p. 395, covering the recent action of the Province of Quebec Association of Architects to restrict the activities of engineers in building design and construction is of particular interest at this time when frequently the professional approach of trained technicians to their work is maintained with difficulty in the face of the increasingly strong pressure of the union movement to absorb technical as well as labor activities. Such *friction between the engineering and architectural professions can only result in a loss of prestige to one or both of the contending parties.*

Some years ago, a celebrity in the field of construction said, "The architect thinks the engineer is a hard-boiled egg, and the engineer thinks the architect is a soft-shelled crab." Among some engineers the idea prevails that the architect is merely a maker of "pretty pictures,"—that his function is solely to "dress up" an otherwise plain structure, as one would decorate a cake with icing. Among some architects, the engineer is merely a necessary evil required to do the routine work of making the architect's drawings hang together.

Actually, there is nothing more futile or feeble than the attempts of an otherwise competent engineer to apply "architecture" to his structures; unless specially qualified; he hasn't the training or taste to do so with happy results. The efforts of an architect without special training to invade the engineering field is rare, and is naturally unsuccessful when attempted.

Fortunately, between competent and discerning practitioners of both professions there exists,—and there should exist,—a mutual respect for their individual abilities, based on the realization that no important building project has been, or can be, an outstanding success without the respective training, experience, and skill of engineers and architects coordinated toward a common result.

In a building project of any size, the engineer must depend on the planning skill of the architect, the architect on the construction skill of the engineer. The item of utility commands the skill of the mechanical, the electrical, (and in the industrial field, the chemical) engineer; in strength, the structural engineer.

It is a tribute to the modesty of the engineering profession that the structures which have made the creative and imaginative conceptions of celebrated architects possible, and which have made their reputations secure, have been designed structurally, mechanically, and electrically, by engineers who are anonymous, or generally unknown to the lay public. Yet the engineers who have made magnificent skyscrapers a characteristic symbol of American ingenuity by patient research and driving tenacity of purpose, might never have attempted such projects if not spurred on by the expansive imagination of the architect's conception which challenged their skill to the actual production.

The judges in the Quebec case referred to are wholly correct in stating that "each case of controversy between engineers and architects must be decided on the facts at issue in each case." The writer feels strongly that there is no basis for controversy between engineers and architects; any overlapping of functions occurs in very minor cases only, and engineers and architects will be wise to avoid such issues. Educated men should be well able to gauge the limitations of their own training and experience, without recourse to the law courts.

There are codes of ethics. Better, there are license laws for engineers and architects designed for the public's protection in safety, health, sanitation, and freedom from eyesores. There should be no facts at issue between the professions; if either the practicing engineer or architect feels impelled to invade the field of the other, let him meet the legal requirements and qualify for license in the field which he desires to enter. If this course is followed, engineers and architects can cultivate the mutual respect of trained specialists of equal attainment for each other, a respect which will develop the harmony and solidarity of these basic professions, and establish them more firmly in the minds of a public.

ERIC FLEMING,
Architect and Engineer,
New Brunswick, N. J.

Tide Locks in Canals

Sir: Having taken part in the construction of all new lock canals built in Sweden during this century, I read with great interest your article "Puzzle in Panama" (*ENR*, May 1, 1947, vol. p. 739).

In my opinion, both from the point of view of capacity and safety a sea-level canal cannot but be superior to a lock canal, although I am afraid that the tide lock proposed will possibly become a bottleneck. Nevertheless, it seems to be possible to design a lock of a width and length sufficient to enable a vessel to pass through without being forced to stop and moor.

In case of a maximum lift of 10 ft., and locking a vessel of a length of 1,000 ft., I estimate that the necessary length of the lock chamber could be kept under a limit of about 2 miles if the average velocity of the vessel would be about 2 knots. In my calculation I am taking into account the wave action in the lock chamber when filling or emptying it; nevertheless, it is necessary to make a thorough investigation of the influence of waves and currents as soon as the lock type is definitely established.

The lock chamber should be provided with the same section as the canal and constructed as a part of it; the gate to be carried out in the same width as the lock chamber. The gates are to be designed as movable dams capable to be operated against full hydrostatic head on either side and able to discharge water masses—when filling or emptying the lock chamber—in such a way that there would be no troubles for the vessels passing through the locks.

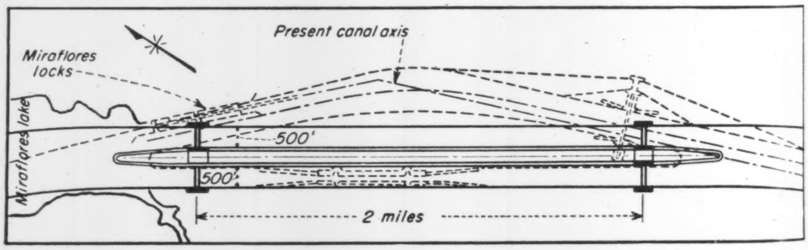
A tide control scheme with locks built according to the above mentioned principles could be arranged in conformity with the attached sketch (elaborated on the basis of your Fig. 8). Both locks would be used as navigable passes when the head was not too high.

Although the lock gates should be operated as moveable dams for letting water out or into the lock chamber, perhaps even directly through the locks, it seems to be advisable to have a certain water-control structure built in a separate canal in order to draw off a part of the water quantity from the locks. The water-control canal is to be situated between the locks in order to grant an adequate distribution of the current in the vicinity of the lock entrances.

In accordance with these principles we have built, in 1941, in Sweden a lock with the following dimensions: length 3,333 ft.; width in the gate chamber 94 ft.; width in the lock chamber 133 ft. at the bottom and 267 ft. at the surface; head up to 3 ft. 4 in.

I should be very glad if my ideas would be of any use in solving the Puzzle in Panama. At all events I express my thanks for your very stimulating article.

HERMAN JANSSON,
Chief Engineer,
Stockholm Harbour Board,
Stockholm, Sweden



Proposal for a two-mile long tide lock in a Panama sea-level canal based upon experience with a six-year old lock in Sweden. The dotted lines represent one of the proposals suggested by the American engineers, as shown in Fig. 8 on vol. p. 746 of the May 1, 1947, issue of ENR.

UNIT PRICES BID BY CONTRACTORS

Dredging at Two Harbors, Minnesota

OWNER: War Department, Duluth District, Corps of Engineers, Duluth, Minnesota.

PROJECT: Construction of a new east breakwater, removal of the existing east breakwater, enlargement of harbor basin by dredging, and other incidental work at Two Harbors, Minnesota. The new breakwater will be 1630 ft. long when completed, its cribs 30 ft. wide. 325 ft. of shore connection will be rubble mound construction and the remaining 1305 ft. timber crib breakwater on rubble foundation.

CONDITIONS: Contractor is to furnish all plant, labor, materials, and equipment except materials furnished by U. S. Plants available for use by contractor are dredging plant, floating plant, and plant including necessary cranes, compressors, etc. for miscellaneous operations and constructing crib. Stipulated contract time is 720 days. The tentative completion date is October 9, 1950. Access to job site is available by rail, highway, and water. Minimum wage rates per hr. range from $0.675 to $1.50 for carpenters, $0.925 to $1.75 for power equipment operators, and $1.25 to $1.87 for marine construction labor. Unskilled labor wage rate is $1.00 per hr.

BIDS: Three bids were received, ranging from the contract low of $2,478,422 to $2,679,560. Contract was awarded June 11, 1947.

LIST OF BIDDERS:

1. Zenith Dredge Co., Duluth, Minn. (contract)	$2,478,422
2. Great Lakes Dredge & Dock Co., Chicago, Ill.	2,547,542
3. Merritt-Chapman & Scott Corp., Cleveland, O.	2,679,560

Item	Quantity	Government Estimate	Unit Prices (1)	Unit Prices (2)
1 Removal of existing east breakwater	lump sum	$134,300.00	$40,000.00	$101,140.00
2 Breakwater stone	400,000 ton	4.04	4.50	5.10
3 Framing and placing timber cribs	2,818 Mf bm	78.56	98.00	64.00
4 Steel; bolts; washers and miscellaneous	139,300 lb	.14	.11	.10
5 Steel; drift bolts; and spikes	258,100 lb	.112	.10	.10
6 Steel; ice guard plates	162,100 lb	.123	.155	.10
7 Dredging, common	105,000 cy	.62	1.20	.60
8 Dredging, rock	17,000 cy	8.48	10.00	6.30

Main Embankment of the Garrison Dam, Bismarck, N. D.

OWNER: War Department Corps of Engineers, Garrison District, Bismarck, North Dakota; John S. Seybold, District Engineer.

PROJECT: Excavation and construction of rolled earth-filled main embankment of the Garrison Dam near Riverdale, North Dakota on the Missouri River. Work includes moving 11,000,000 cu. yds. of earth on the west side of the Missouri, first piece of the dam itself; building and lining a test diversion tunnel on the west side; driving 380,000 sq. ft. of sheet piling to prevent seepage downstream under the dam; and stockpiling an estimated 390,000 cu. yds. of lignite coal which they will uncover. This contract comprises only about one-seventh of the dirt which will have to be removed before the dam is completed.

CONDITIONS: Government will furnish all coarse and fine concrete aggregate and sand for grouting f.o.b. Stanton, N. D.; steel sheet piling as required for East Abutment f.o.b. Riverdale, N. D., and all material required for crusher blocks testing instruments. Access to job site is by rail and highway. Government is constructing a temporary construction bridge at the damsite across Missouri River to be completed by January 1, 1948. Government has constructed an access road from the construction bridge eastward to connect with U. S. Highway No. 83. Highway facilities west of the Missouri River are limited to secondary county roads connecting with North Dakota Highway No. 25. Stipulated contract time is 785 calendar days, or completion by November 12, 1949. Minimum wage rates specified are: power equipment operators, $.90 to $1.50 per hour; ironworkers, $1.75; carpenters, $1.45; electricians, $1.65; cement finishers, $1.35; mechanics, $1.40; miners, $1.30; air tool operators, $.90; tunnel laborers, $.90; and unskilled laborers, $.85.

BIDS: Eight bids were received, ranging from the contract low of $6,349,830 to $11,850,929. Contract was awarded September 12, 1947.

LIST OF BIDDERS:

1. H. N. Rodgers & Sons Co., Memphis, Tenn. Forcum-James Co., Dyersburg, Tenn. S. K. Jones Const. Co., Memphis, Tenn.	$6,349,830
2. United Construction Co., Winona, Minn.	7,592,087
3. Garrison Constructors, Sioux City, Iowa	7,771,700
4. S. J. Groves & Sons Co., Minneapolis, Minn. C. F. Lytle Co., Sioux City, Iowa Bowen & McLaughlin, Phoenix, Ariz.	7,953,785
5. Mittry Brothers Const. Co., Los Angeles, Calif	8,774,444
6. Morrison Knudsen Co., Inc., Boise, Idaho Macco Corporation, San Bruno, Calif. Peter Kiewit Sons Co., Omaha, Nebraska	9,377,043
7. Guy F. Atkinson Co., San Francisco, Calif. Bressi & Bevanda Constructors, Inc., Los Angeles, Calif. A. Teichert & Son, Inc., Sacramento, Calif. W. E. Kier Const. Co., Los Angeles, Calif.	9,886,696
8. George M. Brewster & Son Inc., Bogota, N. J.	11,850,929

Item	Quantity	Government Estimate	Unit Prices (1)	Unit Prices (2)
1 Clearing and Grubbing	Lump Sum	$84,400.00	$85,000.00	$277,960.10
2 Stripping	145,000 cy	.34	.40	35
3 Excavation—Intake & Powerhouse Area	9,625,000 cy	.38	.36	.46
4 Excavation—Outlet Channel Area	369,000 cy	.41	.36	.46
5 Excavation—Intake Channel Area	1,145,000 cy	.43	36	42
6 Excavation—Trench	453,000 cy	.27	.46	.46
7 Excavation—Lignite Salvage	300,000 cy	48	.55	70
8 Rock Salvage	100,000 cy	1.74	.25	.01
9 Pumping	30,000 Mil f gal	3.54	5.00	1.50
10 Rolled Fill—Impervious & Random	10,250,000 cy	.13	.04	.05
11 Rolled Fill—Pervious	805,000 cy	.10	.04	.05
12 Water for Compaction	123,000 M gal	2.32	1.60	.75
13 Additional Rolling—2 Passes	920,000 sq	.037	.015	.02
14 Lignite Stockpiling	390,000 cy	.073	.04	.01
15 Lignite Compaction—Roller; 2 Passes	193,000 sq	.046	.02	.02
16 Lignite Compaction—Tractor; 2 Passes	150,000 sq	.09	.02	.03
17 Lignite Protective Fill	90,000 cy	.21	.04	.25
18 Furnishing Steel Sheet Piling	31,000 lf	1.74	1.84	3.22
19 Driving Steel Sheet Piling	286,400 lf	1.26	1.00	.96
20 Settlement Gage—13 Ft. Length	16 ea	980.00	150.00	510.00
21 Settlement Gage—Additional Length	800 lf	28.60	3.00	14.60
23 Tunnel Excavation	11,200 cy	21.62	22.00	16.04
24 Timber Support	30 Mf bm	442.50	300.00	405.00

Continued on page 84

Main Embankment of the Garrison Dam, Bismarck, N. D.

Continued from page 83

25 Furnishing Structural Steel Support	1,585,000 Lb	.13	.09	.12
26 Installing Structural Steel Support	1,400,000 Lb	.075	.065	.06
27a Drilling—Concrete	100 lf	2.65	5.00	14.45
27b Drilling—Ft. Union	2,000 lf	2.60	1.00	3.50
28 Grout Pipe	600 lf	1.68	5.00	3.28
29 Pressure Grouting	5,000 cf	2.22	3.00	3.50
30 Concrete Tunnel Lining	930 cy	55.65	85.00	74.50
31 Steel, Reinforcement	100,000 lf	.14	.10	.18
32 Portland Cement	3,060 bbl	5.58	4.50	5.00
33 Permanent Tunnel Drain	450 lf	2.50	3.00	9.39
34 Embedded Electrical Conduit	1,000 lb	1.40	.50	2.40
35 Vitrified Clay Pipe—12 Inch	255 lf	4.20	3.00	10.88
36 Vitrified Clay Pipe—18 Inch	276 lf	7.10	5.00	16.00
37 Vitrified Clay Pipe—24 Inch	500 lf	10.37	7.00	20.00
38 Bank-Run Gravel	2,300 cy	1.08	1.00	1.67
39 Manhole—8 Ft. Depth	5 ea	304.00	500.00	600.00
40 Manhole—Additional Depth	47 lf	18.50	25.00	20.00

Water Storage Tank, Bismarck, North Dakota

OWNER: City of Bismarck, North Dakota; Lium and Burdick, Engineers.

PROJECT: Construction of a 500,000 gallon storage tank, booster pumping station and water mains within Watermain and Waterworks District Number 61 of the City of Bismarck, North Dakota. A great deal of the ditch must be dug in loose gravel soil which flows freely, thus, requiring shoring while the ditch is being dug. Numerous connections are to be made to the present water system and many of the present system connections are not shown on the plans, requiring extra precautions in digging. Much shoring and tamping is necessary in placing watermain 9 ft. below ground not to disturb gas main 4 ft. below ground level.

CONDITIONS: City of Bismarck, N. D. will furnish all of the cast iron pipe, cast iron fittings, gate valves and boxes, fire hydrants, lead and jute. Material to be furnished to the contractor to amount to approximately $240,000. Among the materials to be furnished by the contractor are air release valves, air release valve manholes, gate valve manholes, pit run gravel fill, pump house, flow meter and 500,000 gallon storage reservoir. Project must be completed not later than January 1, 1949. Access to job site is by rail and highway. Skilled labor wage rate is $1.75 per hour; semi-skilled, $1.45; and common, $.90.

BIDS: Seven bids were received, ranging from the contract low of $246,673.45 to $313,055.80. Contract was awarded August 21, 1947.

LIST OF BIDDERS:

1. Delzer Construction Co., Bismarck, N. D.	$246,673.45
2. Paul R. Kemper, Minot, N. D.	265,921.70
3. Rue Construction Co., Bismarck, N. D.	268,942.33
4. Northern Improvement Co., Fargo, N. D.	283,980.11
5. Northwestern Engr. Co., Rapid City, S. D.	299,850.96
6. G. E. Haggart, Fargo, N. D.	312,978.10
7. J. A. Shaw, Fargo, N. D.	313,055.80

Item	Quantity	Unit Prices (1)	(2)	(3)
1 C.i. main, 18"—west of Bell St	6,535 lf	$4.02	$3.00	$4.25
2 C.i. main, 18"—east of Bell St	3,203 lf	4.27	5.20	4.25
3 C.i. main, 16"—Ave. "A" to 11th St	14,317 lf	4.36	5.00	4.55
4 C.i. main, 16"—Boulevard to tank	3,462 lf	4.51	3.00	4.64
5 C.i. main, 12"—Nineteenth St	1,786 lf	3.27	2.80	3.00
6 C.i. main, 12"—Fifteenth St	2,746 lf	3.07	2.80	3.00
7 Existing 12" connections	60 lf	5.00	6.00	7.50
8 C.i. main, 10"	1,548 lf	2.44	2.25	2.80
9 C.i. connections, 10"	226 lf	5.10	5.00	7.00
10 C.i. main, 8"	7,674 lf	1.90	1.90	2.30
11 C.i. connections, 8"	341 lf	3.49	4.00	6.00
12 Existing 8" connections	160 lf	4.50	2.70	6.00
13 C.i. connections, 6"	665 lf	4.31	3.50	4.00
14 Existing 6" connections	700 lf	4.00	2.05	4.00
15 Cast iron fittings	95,820 lb	0.06	0.10	0.06
16 Gate valves, 18"	7 ea	70.00	102.00	90.00
17 Gate valves, 16"	25 ea	67.00	81.60	65.00
18 Gate valve & box, 12"	23 ea	62.00	68.00	65.00
19 Gate valve & box, 10"	12 ea	40.50	54.40	50.00
20 Gate valve & box, 8"	51 ea	29.00	40.80	30.00
21 Gate valve & box, 6"	60 ea	24.50	34.00	22.00
22 Gate valve & box, 4"	1 ea	30.00	27.20	20.00
23 Fire hydrant, 6"	18 ea	50.00	54.40	50.00
24 Fire hydrant, 8"	4 ea	75.00	81.60	60.00
25 Air release valves	2 ea	100.00	68.00	100.00
26 Air release valves	2 ea	400.00	204.00	300.00
27 Gate valve manholes (no. 1)	32 ea	225.00	204.00	300.00
27a Gate value manholes (no. 2), alternate	32 ea	250.00	......	300.00
28 Cutting pavement & driveways	20,000 sf	0.25	0.55	0.50
29 Pit run gravel fill	1,000 cy	2.00	3.40	2.00
30 Tamping backfill	6,000 sy	0.50	1.40	0.50
31 Restoring sod	100 sy	1.50	1.40	1.50
32 Pump house	1 ea	8,806.00	8,000.00	9,500.00
33 Pump connections	1 ea	650.00	680.00	800.00
34 Pump—electric, 1500 GPM	1 ea	2,500.00	2,720.00	2,500.00
35 Pump-dual drive, 1500 GPM	1 ea	4,200.00	4,350.00	3,900.00
36 Flowmeter	1 ea	750.00	544.00	700.00
37a Pressure tank—concrete—earth cover	1 ea	35,122.00	40,000.00	40,121.00
38 Rock excavation	50 cy	20.00	27.00	20.00
41 Existing 16" connections	60 lf	5.00	5.00	8.50
42 Removing existing 6" water pipe	222 lf	0.00	3.00	0.50

Reinforced Concrete Bridge, Los Angeles, Calif.

OWNER: State Division of Highways, Los Angeles, California; G. T. McCoy, State Highway Engineer.

PROJECT: Construction of a reinforced concrete bridge with a 48-foot roadway across the Los Angeles River at Florence Avenue near the City of Bell, Calif. Grading and paving of approximately 0.26 miles of road with asphaltic concrete pavement and pre-mix pavement.

CONDITIONS: All materials are to be furnished by the contractor. Stipulated contract time is 350 working days. Access to job site is by rail and highway. Minimum wage rate for skilled labor is $1.50 per hour; for semi-skilled, $1.40; and for common, $1.35.

BIDS: Eleven bids were received, ranging from the contract low of $419,162.00 to $546,768.10. Contract was awarded August 29, 1947.

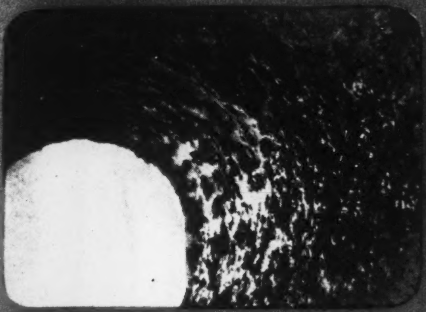
LIST OF BIDDERS:

1. H. B. Nicholson, Pasadena, Calif.	$419,162.00
2. Guy F. Atkinson Co., San Francisco, Calif	439,737.00
3. MacDonald, Kruse & Hensler, Glendale, Calif.	439,929.50
4. W. J. Disteli, Los Angeles, Calif.	443,061.00
5. Peter Kiewit Sons Co.	453,106.00
6. Carlo Bongiovanni, Hollywood, Calif.	462,785.60
7. Dimmitt & Taylor & K. D. Nicholas, Los Angeles, Calif.	467,606.50
8. Byerts & Dunn, Los Angeles, Calif.	481,948.50
9. Griffith Co., Los Angeles, Calif.	490,384.30
10. Oberg Bros., Inglewood, Calif.	545,865.00
11. Haddock Co., Pasadena, Calif.	546,768.10

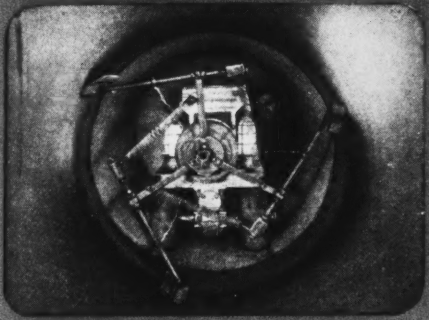
Item	Quantity	Unit Prices (1)	(2)	(3)
1 Removing existing bridge	lump sum	$25,000.00	$11,000.00	$15,000.00
2 Removing concrete	460 cy	3.00	5.00	4.00
3 Clearing & grubbing	lump sum	2,000.00	1,100.00	4,000.00
4 Roadway excavation	3,700 cy	1.00	.60	.50
5 Structure excavation	3,450 cy	12.00	6.00	14.00
6 Imported borrow, type B	18,000 cy	1.25	.90	.85
7 Imported borrow, type A	4,300 tons	2.00	2.25	1.50
8 Preparing class "C" subgrade	16,100 sy	.15	.11	.15
9 Applying water	600 M gal	2.00	3.00	2.00
10 Class "A" P.C.C. (footing blocks)	883 cy	20.00	25.00	30.00
11 Class "A" P.C.C. (structure)	2,800 cy	42.00	60.00	51.25
12 Class "A" P.C. mort. (railing base)	5.5 cy	80.00	100.00	20.00
13 Misc. steel	12,500 lb	.30	.30	.35
14 Steel railing	906 lf	6.50	10.50	12.00
15 Furnishing concrete piling	17,010 lf	2.80	2.80	2.75
16 Driving piles	390 ea	30.00	30.00	50.00
17 Driving test piles	2 ea	150.00	200.00	200.00
18 Light stone riprap	240 cy	10.00	15.00	15.00
19 Class "A" P.C.C. (curbs, gutters & sidewalks)	450 cy	30.00	35.00	30.00
20 Furnishing bar reinforcing steel	775,000 lb	.06	.05	.053
21 Placing bar reinforcing steel	775,000 lb	.02	.03	.018
22 Engineers office	lump sum	2,000.00	1,000.00	2,000.000
23 Pre-mix pavement	280 tons	5.00	7.00	3.75
24 Asphaltic concrete pavement	3,700 tons	6.00	6.00	3.75
25 Sanitary sewers	lump sum	2,500.00	2,845.00	2,500.00

CENTRILINE

cement-mortar lining of water mains



BEFORE—Typical example showing incrustation and tuberculation inside of water main.



AFTER—Centriline process includes scientific cleaning and application of cement-mortar lining.

COMPACT SERVICE UNIT—Typical American mobile unit, compact and complete for on-the-job service.

Quality pipe line products manufactured and installed by American include—Lock Joint Concrete Cylinder Pipe, Prestressed Lock Joint Concrete Cylinder Pipe, American Concrete Cylinder Pipe, Centrifugal Concrete Pressure Pipe.

Main Offices and Plant—
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District Offices and Plant—
Oakland San Diego Portland, Oregon

. . . a service of

American
PIPE AND CONSTRUCTION CO.

in the Western States

When metal water mains lose efficiency, Centriline service by American may solve your problem. A rapid, economical method of reconditioning such pipe lines, the Centriline process is performed underground—in place. After cleaning the pipe, a thoroughly premixed cement-mortar lining of desired thickness is applied centrifugally without rebound. This dense, quality product is then mechanically trowelled to form a smooth, durable surface.

The Centriline process means distinct advantages to you, because it—

- Restores and maintains maximum hydraulic capacity.
- Prevents interior corrosion and tuberculation.
- Provides effective sustained service; offers a real economy in its application.
- Is accomplished rapidly, minimizing inconvenience to surface traffic.

The American Pipe and Construction Co. has enjoyed a wide experience in the field of water supply line engineering and construction over a long period of years and this experience and training are available to water works officials and engineers.

Write for more detailed information concerning the remarkable Centriline Process.

Centriline Division of

AMERICAN PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines

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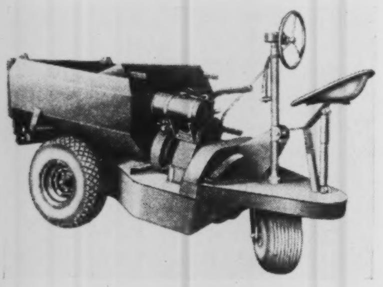
Phone: JEfferson 4211

New Aids to the Constructor

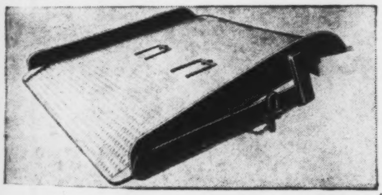
MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

ONE-MAN IMPACTOR—A new impacting machine that handles like a lawn-mower, the Wayer impactor, is a one-man unit that tamps to maximum density such materials as asphalt, concrete, resurfacing, and patching. It is also used to pack down gravel, stone and clay. It is said to travel at the rate of 32 ft. per min. while tamping; it can be operated in gutters and around manholes where rollers cannot be used. It provides 2,200, 1,500 lb. drives or impactions per minute, and uses only 3 gal. of gasoline for the entire day. Impactors are available in two models. Model No. 20 is designed for medium-heavy jobs and weighs less than 200 lbs. Model No. 36 is built for rugged use and handles heaviest requirements.—*Chicago Precision Machine Co., 920 South Michigan Ave., Chicago 5, Ill.*



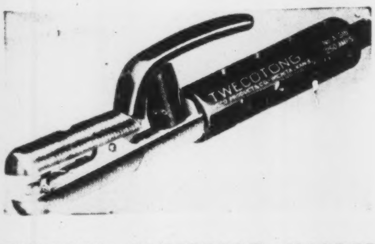
MECHANIZED WHEELBARROW—A mechanized wheelbarrow capable of carrying a one-ton load at speeds up to 15 mph., called Scootruk, is virtually a miniature dump truck. It is built to haul concrete, sand, bricks, etc. and is equipped with special airplane type tires to run anywhere. It can be used for scaffold or second and third story work since it weighs only 1,000 lb. Steering is by a single tail wheel, permitting easy maneuvering; power is supplied by a 6 hp. air-cooled Novo engine with 4-speed transmission and reverse.—*Novo Engine Co., Lansing, Mich.*

PORTABLE WELDER—A new self-powered arc welder, P&H Model WN-200, available as a stationary or trailer unit, is an N.E.M.A. rated machine of 200 amperes, but has a welding service range of from 30 to 260 amperes. Both types have engine and welder mounted on an all-welded frame of sturdy steel tubing and heavy angle iron. The trailer model has been engineered especially for use in the field. Carried on a running gear of standard track width, the trailer welder has standard size pneumatic tires as regular equipment.—*Harnschfeger Corp., Milwaukee, Wis.*



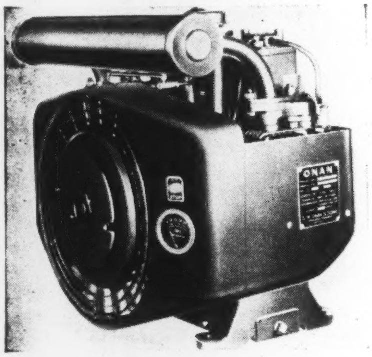
BRIDGE RAMP—Designed for use with fork trucks on railroad sidings, new ramp has load capacity of 15,000 lb. and can be placed and secured by one person in less than 2 min. There is size and type to span gaps from 5 to 58 in., with differential in heights up to 7 in. Riding surface is non-slip steel plate reinforced with shock plates at corners.—*Elizabeth Iron Works, P. O. Box 360, Elizabeth, N. J.*

PLYWOOD—"Welchboard," a new plywood product is manufactured from pulverized wood waste bound together with waterproof resin, on a base of $\frac{3}{8}$-in. plywood. The "extra ply" forms a smooth, hard, durable surface affording superior appearance and finishing properties for interior and exterior walls of homes.—*West Coast Plywood Co., Aberdeen, Wash.*



WELDING ELEGTRODE HOLDER—New A-316 Twecotong electrode holder features light weight, compactness and ease of operation with 95-lb. bite on $\frac{3}{16}$ in. electrode. Tip and body insulation is molded laminated glass cloth bakelite using patented tubular-keyed design. Insulated spring is neoprene covered. Cable connection is simple clamp, plus socket for soldering when desired. Specifications are: Capacity 1$\frac{1}{16}$-in. through $\frac{3}{16}$-in. electrodes; 250 amp.; weight 18 oz.; length 9 in.; palm span 2$\frac{3}{4}$ in.—*Tweco Products Co., P.O. Box 666, Wichita 1, Kan.*

FORK LIFT TRUCK ACCESSORY—Revolving carriage is designed for handling solid, liquid or granular bulk materials which must be poured from one container to another. It revolves in 360-deg. vertical circle in either direction. Power is supplied by hydraulic motor through chain drive.—*Towmotor Corp., 1226 E. 152nd St., Cleveland 10, Ohio.*



GASOLINE ENGINE—New Onan CK engine is 10-hp., 4-cycle, air-cooled prime mover. Weighing only 97 lb., it has endurance of engines several times that weight. Direct-connected electric starter, which is built into flywheel as integral part, is optional feature. It also serves as generator during operation of engine for charging starting battery.—*D. W. Onan & Sons, Inc., 43 Royalston Ave., Minneapolis, Minn.*

MIXED FLOW TYPE PUMP—New pump embodies essential characteristics of both centrifugal and axial flow pumps, including ability to move liquids against maximum heads with minimum submergence, adaptation to shallower sumps, utilization of higher speed motors against medium heads and installation in minimum space.—*Peerless Pump Division, Food Machinery Corp., 301 W. Ave. 26, Los Angeles, Calif.*

Kodak

Eastman Kodak Company announces

THE BIG NEW PLUS

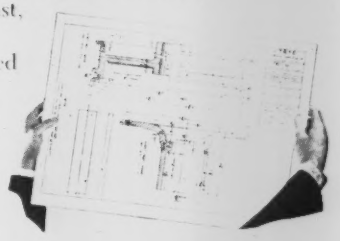
in engineering drawing reproduction . . .

Kodagraph Papers

With this—the announcement by Eastman Kodak Company, world's outstanding maker of photographic materials, of a new line of reproduction papers—you'd naturally expect a big new plus. And you're getting it: first—new Kodagraph Contact Paper which brings new features, new effectiveness to existing photographic reproduction methods. Second—revolutionary new Kodagraph Autopositive Paper that brings the unique advantages of photographic reproduction to direct process and blueprinting equipment.

The PLUS that Kodagraph Contact Paper brings to photocopying

Photographically, you can do things that can't be done any other way. You can get better printability from old and new drawings . . . reproduce blueprints, opaque drawings. And the plus Kodagraph Contact Paper brings to this is the assurance of brilliant contrast, wide latitude, flatness, long-lived legibility, and dependable uniformity.



The PLUS that Kodagraph Autopositive Paper brings to direct process and blueprinting equipment

Truly revolutionary . . . this new Kodagraph Autopositive Paper. Exposed in direct process or blueprint machines, it brings the advantages of photography to the making of masters of new tracings for highest quality prints . . . to the restoration of "unprintable" tracings, the reproduction of blueprints or opaque drawings. Does this directly—no negatives—in your present equipment, in ordinary room light.

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For unsurpassed photocopying—Kodagraph Contact Paper. For direct process and blueprinting equipment—Kodagraph Autopositive Paper. And for printing from reduced-scale negatives, there are Kodagraph Projection Papers. To survey the possibilities of this Kodagraph line—quickly—write for "The Big New Plus."

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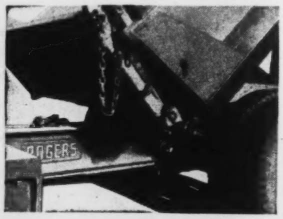
1 LOAD FROM THE FRONT

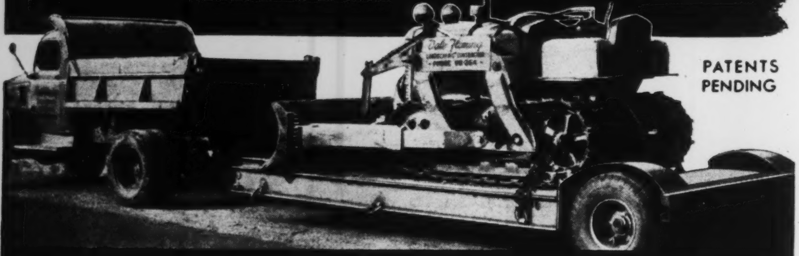
CONNECT 2 TO YOUR DUMP TRUCK

Showing cable around sheave and dump body about to be raised to engage towing tongue.

Body elevated. Tightened cable has raised drawbar and engaged towing tongue. Safety coupling pin is inserted.



and you're 3 READY TO ROLL with "TAGALONG" Front Loader



PATENTS PENDING

A welcomed boon to contractors everywhere, the "Tagalong" frontloader requires no tractor. Light and medium shovels, cranes, bulldozers, etc., are moved to and from the job rapidly and economically, with your dumptruck doing double-duty.

Equipment used to adapt the truck constitutes a negligible weight and does not in the least impair usefulness of the vehicle.

THE INSTALLATION IN NO WAY OBSTRUCTS THE DUMP BODY OR ITS NORMAL OPERATION.

Write for particulars.

ROGERS BROS. CORP.

DESIGNERS and BUILDERS OF HEAVY DUTY TRAILERS SINCE 1915

EXPERIENCE builds 'em *PERFORMANCE sells 'em*

135 ORCHARD ST. ALBION, PENNA.

Men and Jobs

Richard W. Willis, assistant chief engineer of the Burlington Railroad, under whose supervision most of the company's principal yards and terminals during the last quarter-century have been built, has retired after 49 years service.

Russell E. Wilson has been named traffic engineer on the staff of the traffic and planning division of the Delaware State Highway Department. He is a graduate of Purdue and Cornell.

William B. Ainsworth, a graduate in civil engineering, June, 1947, University of Illinois, is inspecting construction on a large oil refinery and pumping station in Amvay, Venezuela.

C. H. Perry of Eau Claire, Wis., has been appointed city engineer of Marshfield, Wis. Mr. Perry is a graduate of Tri-State College of Engineering of Angola, Ind. He worked for the Chicago & Northwestern Railroad and until 1941 was with the Wisconsin State Highway Commission. He then went to Panama and worked on the Gatun Third Locks project. During the war he was a lieutenant, j. g. in the Navy. Until his new appointment he was in the engineering department of the U. S. Rubber Co. at Eau Claire.

C. L. Butler, formerly superintendent for Charles H. Tompkins Co., Washington, D. C., is now with Walter B. Avery, building contractor, in the same city as estimator and engineer.

Walter N. Renwick Jr. will replace **Harold Kohler** as resident engineer for the U. S. Engineers at the Veterans Administration Hospital project in Buffalo, N. Y. Mr. Kohler, who has been with the engineers 22 years, is resigning to return to his native Texas and enter private industry. Mr. Renwick served with the Corps of Engineers for 4½ years during the war and was discharged with the rank of major.

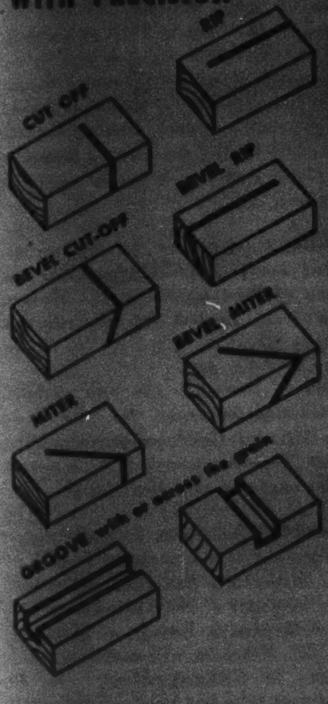
George Spence, chief engineer and director of the Prairie Farm Rehabilitation Administration of Canada, has been named a member of the International Joint Commission, which handles boundary disputes between Canada and the United States.

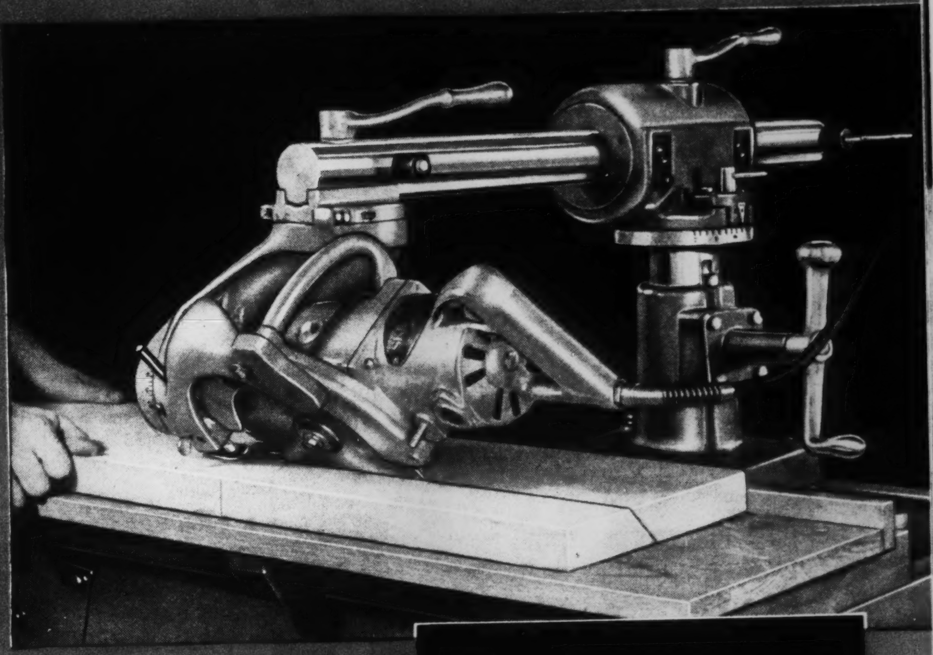
Ernest H. Stork, assistant city planning engineer at Columbus, Ohio, and

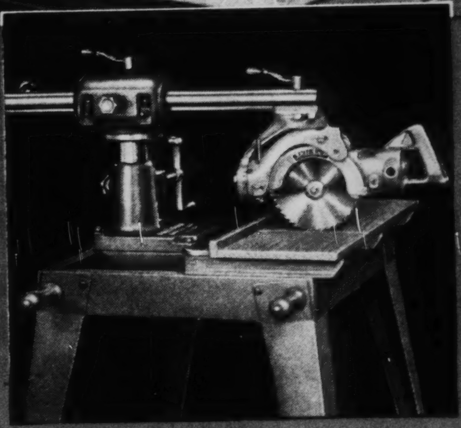
MULTIPLY YOUR SKIL SAW'S MANY USES with a SKIL SAW RADIAL SUPPORT

Quickly Converts Portable Electric SKIL SAW into an Efficient Radial Saw*

MAKES ALL THESE CUTS WITH PRECISION


RIP
CUT OFF
BEVEL RIP
BEVEL CUT-OFF
BEVEL MITER
MITER
GROOVE with or across the grain





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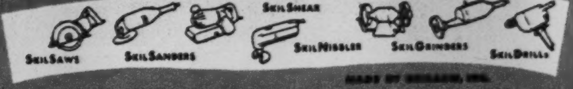
ELECTRIC PNEUMATIC
SKILTOOLS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MEMO
TO ALL CONSTRUCTION SUPTS.:
To Lower Costs in Getting out Gravel
... the functional "rightness" of Haiss Loader design, its heavy-duty, oil-bath enclosed transmission, and its stand-up-to-the-job ruggedness, make it a logical first choice. Better investigate today!
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MacARTHUR CONCRETE PILE CORPORATION
18 EAST 48th STREET, NEW YORK 17, N. Y.
BOSTON • CINCINNATI • NEW ORLEANS

a veteran of 32 years municipal service, has resigned to be on the staff of the Franklin County Planning Commission, to work with the zoning board. The county plans to zone unincorporated territory.

S. P. Carman, a Binghamton, N. Y., consulting engineer and former chief of that city's bureau of water, has been selected as consulting engineer for construction of the $4,700,000 Broome County Airport near Binghamton.

Albert E. S. Hall, staff civil engineer of the engineering department of the Du Pont Co., Wilmington, Del., has retired after 29 years service. He attended the college of the City of New York and Wilson Engineering School, Cambridge, Mass. His first job was on the New York Central Railroad and he later went to the New York City Board of Water Supply. He was employed by Du Pont in 1918 as a draftsman in the design division and in the subsequent years he advanced to become the company's principal architect and civil engineer. During the war he worked on the design and layout of war plants and was active in plant site selections.

Clyde C. Spencer has been appointed construction engineer for the Bureau of Reclamation at the Hungry Horse Dam project in northwestern Montana.

Fred S. Nance is the new division maintenance engineer for the Iowa State Highway Commission, succeeding **Robert Tutton** promoted to assistant district engineer at Cedar Rapids.

Donald C. Ketcham, formerly assistant manager of the regional branch of power utilization, has been designated acting manager of the Yellowstone District of Region 6, Bureau of Reclamation. Mr. Ketcham will maintain headquarters in Billings, Mont. **R. H. Workinger,** who has been executive officer of the Bureau's Missouri Basin project activities staff since April, will serve in a similar capacity for the Big Horn District, at Cody, Wyo.

Prior to joining the bureau in 1947, Mr. Ketcham was assistant regional head of the Rural Electrification Administration management division in Washington, D. C. During the war he was in the power supply section of the War Production Board in Washington.

Mr. Workinger has been employed by the Department of the Interior since 1940, with the exception of two and one-half years in the armed forces. From 1934 to 1940 he was in the Works Progress Administration, serving as assistant director of organization.

ADD THIS TO THIS
LORAIN
Self-Propelled Unit
Moto-Crane

. . . . and get the advantages of both in the DUAL CONTROL TL-20

• That's right, dual control—a new, practical TL-20 feature that "lets you have your cake and eat it, too" insofar as mobility is concerned. Here's a two engine unit offering the "get up and go" mobility of the Moto-Crane between jobs and, which on the job, becomes a Self-Propelled unit operated and air steered from the turntable cab and powered for on-the-job mobility by the turntable engine.

Conversion from Moto-Crane to Self-Propelled unit represents a simple 5 minute operation. The TL-20 Moto-Crane, with Dual Control, is available as a 4-wheel unit with front wheel drive or a 6-wheel unit with or without front wheel drive.

TO-THE-JOB MOBILITY The TL-20's rubber-tire Moto-Crane mounting has 8 speeds forward, ranging from 1 to 33 M.P.H., and 2 reverse speeds. There's high speed travel for the highway plus a low speed range and "soft ground flotation" to master rugged off-the-road travel. Neither distance or terrain is a problem to the fast-stepping, sure-footed Moto-Crane.

ON-THE-JOB MOBILITY Conversion to a Self-Propelled unit saves time on the short moves about the job. Once the changeover is completed, the operator merely starts the turntable engine and goes to work. On-the-job travel is powered by the turntable engine at 1 to 8 M.P.H. in either direction. Steering is by air power with all steering and brake controls located conveniently at the operator's position in the turntable cab.

Complete data on the Dual Control TL-20 can be obtained from your local Thew-Lorain distributor.

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**THE
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Lorain, Ohio**

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You can have the BENEFITS of this Versatile

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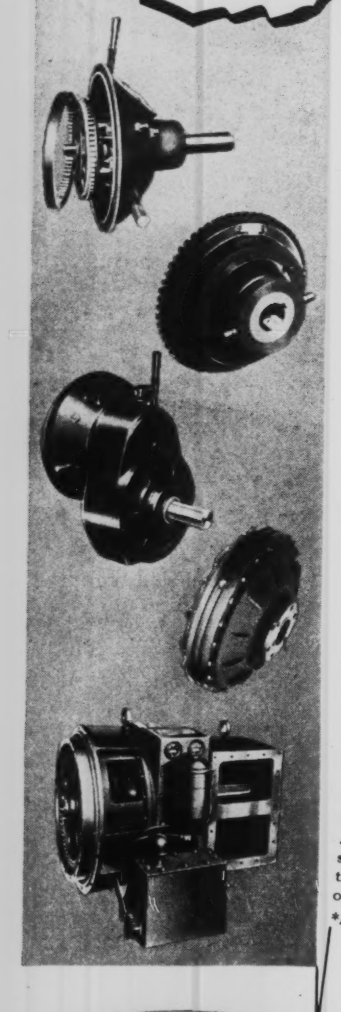


For 29 years, the Twin Disc Clutch Company has specialized in the manufacture of industrial clutches and hydraulic drives . . . not for a single field alone, but for every type of industry. The benefits of this long, *diversified* experience are yours today in the extensive line of Twin Disc Clutches and Hydraulic Drives. Typical examples are illustrated here.

Let Twin Disc Engineers study your individual problems in the transmission and control of power. They are prepared to advise you without bias as to which type of drive—friction or hydraulic—best fits *your* operational picture. Write for additional information today! TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

TWIN DISC POWER TAKE-OFF—Precision construction and liberal safety factors insure long wear-life.

TWIN DISC MODEL E CLUTCH—Fully enclosed design, extreme ruggedness and ease of adjustment and lubrication give the Model E the widest range of application.

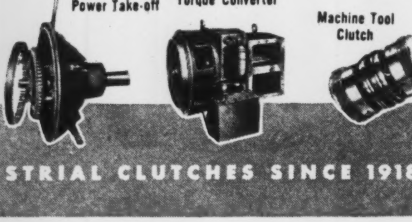
TWIN DISC REDUCTION GEAR—Heavy-duty, unit design incorporates complete power take-off and reduction gear in a single, rigid unit.

TWIN DISC HYDRAULIC COUPLING—Hydraulic principle permits prime mover to develop sufficient rpm for maximum torque regardless of load . . . prevents engine stalling.

TWIN DISC HYDRAULIC TORQUE CONVERTER*—Automatic torque-speed adjustment affords sensitive load control. Converter provides high torque at low output shaft speeds . . . plus all other advantages of hydraulic drive.

**Lysholm-Smith Type.*

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES
REG. U.S. PAT. OFF.



SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

Elections and Activities

Percy B. Sprague, Superintendent of Public Works, Valley Stream, L. I., N. Y. was elected president of the New York-New Jersey Metropolitan Chapter of the American Public Works Association to succeed F. M. Galloway, Superintendent of Public Works, Montclair, N. J. at a recent meeting held at Irvington, N. J. I. J. Casey, Irvington, and William F. Foster, engineering editor of *The American City* were elected vice-president and secretary-treasurer, respectively.

More than 100 municipal officials and engineers took part in the meeting the first part of which consisted of inspection of the Irvington public works garage and incinerator and of various types of equipment used in municipal work. For the benefit of onlookers the Township of Maplewood, N. J., demonstrated its tree sprayer and leaf collector, both pneumatically operated. After this, tours of the Joint Meeting 100 mgd. sewage disposal plant and the Smith Tractor and Equipment Plant were conducted by officials of those organizations.

Two Boise, Idaho, men, Myron Swendsen of the Intermountain Equipment Co., and L. F. Erickson of the materials laboratory of the Idaho bureau of highways, have been elected president and secretary, respectively, of the newly-organized southern Idaho section of the American Society of Civil Engineers. The new section of the organization is made up of former members of the Intermountain section.

The League of Texas Municipalities has elected Phil Hamburger, Houston City commissioner, president; A. A. Bentson mayor of Edcouch, vice-president; H. P. Kucera, Dallas, George Barber, Mineral Wells; B. J. McDaniel, Abilene; Roy Voges, Seguin, and Miss Agnes Sagabiel, Fredericksburg, were elected trustees. Support of the new Texas municipal retirement system, enacted by the 50th Legislature, was pledged in a resolution adopted.

The Texas chapter of the American Public Works Association has been organized. H. H. Hester, Ft. Worth and J. C. Bisset, Dallas, were co-chairmen for organization. Officers elected were H. H. Stearmen, Corpus Christi, president; W. F. Hicks, Paris, vice-president; Bob Sherrill, Vernon, secretary-treasurer.

ADVANTAGES OF RAYMOND CONCRETE PILES NO. 5

saving in construction cost

OTHER ADVANTAGES: Uniform Bearing Capacity • Greater Carrying Capacity • Permanency • Engineered for the Job • Complete Satisfaction

Eleven Raymond rigs in operation on one job—an example of Raymond's ability to speed the work.

50 YEARS FOUNDED 1897 OF PROGRESS

Genuine economy depends on many basic factors and is not always evidenced by the lowest bid.

Whether your job is large or small, you will find Raymond economy is the result of:

1. Sound engineering and planning.
2. Experienced supervision.
3. Equipment readily available anywhere in the country.
4. Experience in purchasing materials at lowest costs from sources nearest the job.

· · · All demonstrated by world-wide experience . . . your assurance of genuine economy.

THE SCOPE OF RAYMOND'S ACTIVITIES includes every recognized type of foundation construction—concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements and borings for soil investigation.

RAYMOND

CONCRETE PILE CO.

Branch Offices in Principal Cities
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OCTOBER
Model 5A 620
Fuller
TRANSMISSIONS

MORE days on the road
LESS time in the shop

Fuller Transmissions and Auxiliaries are built for long wear-life . . . for maximum road service without time-consuming overhauls.

Fuller Transmissions are designed, manufactured and applied by men who are specialists in meeting the transmission requirements of the heavy-duty trucking industry. They are geared for your particular job . . . function more efficiently . . . require less service.

Your trucks will spend more days on the road and less time in the shop if you specify proved-in-the-field and geared-to-the-job Fuller Transmissions and Auxiliaries.

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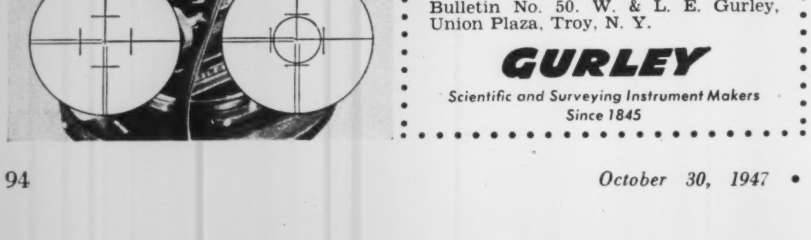

Here's why Gurley Instruments now feature quick-reading glass reticles...exclusively

Study these *new* reticle patterns. Think of them in your Gurley transit. They'll make your surveying job easier.

Here's the latest advance in engineering instruments—glass reticles in patterns to suit all surveying needs—developed by Gurley for added efficiency and accuracy, and incorporated in all new Gurley instruments. Write today for Bulletin No. 50. W. & L. E. Gurley, Union Plaza, Troy, N. Y.

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Scientific and Surveying Instrument Makers
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Manufacturers' Activities

EDWARD M. PAULLIN, after sixteen years with Worthington Pump and Machinery Corp. has resigned to form the Paullin Equipment Co., Inc. The new company with offices at 28 Church Street, Buffalo, N. Y., will deal in new and rebuilt mechanical and electrical equipment. In addition to reconditioning compressors and vacuum pumps the company will act as consulting engineers and manufacturers agents. Other officers are John H. Darby, vice president and Glenn A. Irvin, secretary.

C. FOSTER BROWN has been named general office manager for the Ceco Steel Products Corp., at Chicago 50, Ill.

BARIUM STEEL CORP. announces the purchase of the plant and other physical assets including the inventories and good will of the George King Co., Inc., producers of iron and steel castings at Sheffield, Ala. The King plant and business hereafter will be operated by and under the name of the Sheffield Iron & Steel Co., a Barium subsidiary.

FRANK E. CARROLL, structural engineer, has joined the engineering department of the Timber Engineering Co. He will devote his time to structural designing, timber testing, and sales promotion work with architects, engineers and contractors.

To meet increased demand in Dayton and surrounding areas for acetylene for oxyacetylene welding and cutting process, the AIR REDUCTION SALES CO. has opened a new acetylene plant there. The plant superintendent will be R. K. Haygood.

The industrial department of DRAVO CORP., Pittsburgh, has opened a Chicago office to handle sales and service of Dravo Counterflo direct fired heaters for commercial and industrial heating and Dravo crane cab coolers for air conditioning crane cabs in steel mills, foundries and chemical plants. This office covers northern Illinois and the industrial districts of northwest Indiana. T. W. Eshbach is in charge of the new branch office at 208 S. LaSalle St.

An increase in supply of double-glazed picture windows of standard size for residential construction was announced today by the PITTSBURGH PLATE GLASS Co. Installation of new manufacturing equipment and improvements in production and processing facilities make the increase possible.

A new distributor of Ferro-Therm steel insulation to cover midwest and central states areas was announced by American Flange & Manufacturing Co. Inc., with the setting up and appointment of MIDWEST FERRO-THERM DISTRIBUTORS INC., at 9 South Clinton St., Chicago, Ill. William J. Donahoe, president, will be assisted by Sidney Frisch, William N. Alderman and Arthur C. Heimerdinger.

C. E. MOHRBACHER has been appointed as assistant sales manager of the Racine division of the Twin Disc Clutch Co. Other appointments include: A. E. Young district manager of the West Coast territory; E. H. Bennett district manager of the Eastern territory; W. L. Dixon, consulting sales engineer at Newark; J. B. Jenkins, district manager of the Michigan territory; P. G. Tyrrell, assistant district manager in the territory served by the new Los Angeles office; P. W. Wahler, assistant district manager in the territory served by the Seattle factory branch.

Appointment of CHARLES R. BOREHAM as parts and service manager was announced recently by The Frank G. Hough Co., Libertyville, Ill., manufacturers of road building and material handling equipment.

Welding fittings division of TUBE TURNS, INC., Louisville, Ky., has announced the appointment of Lewis M. Bound, Jr., as West Coast manager, with headquarters in San Francisco.

IRVINGTON FORM & TANK CORP. is opening a district office in Washington, D. C., 805 G St., N. W. with Allan J. O'Brien in charge. A. Karl Wetzig is in charge of a new office at Houston 4, Texas.

JOHN FIES has been retained by the National Lumber Manufacturers Association to represent its technical department on the Pacific Coast.

Effective September 1, 1947, the executive office of the ASSOCIATED EQUIPMENT DISTRIBUTORS has been located at 360 North Michigan Ave., Chicago 1, Ill.

A. M. KUEHMSTED, chief engineer for the Santa Fe Tank and Tower Co., in Los Angeles, for the past 12 years, has been assigned to the New York branch, 400 Madison Ave. for work on cooling towers and the like.

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on the construction job, particularly, a good gas welding and flame cutting outfit is a necessity. on a construction job, however, such an outfit is used largely for emergency repair, for hard facing, for silver brazing and for flame cutting—such an outfit, therefore, must be dependable . . . on the job when needed. and—that quality is one of the numerous reasons why victor welding and cutting equipment is today the most popular and one of the most highly regarded in industry.

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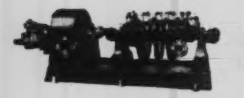
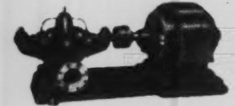


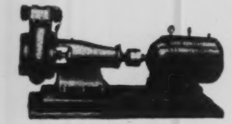
BOILER FEED SERVICE

Peerless Type B multi-stage pumps are designed for boiler-feed, pipe line and refinery services delivering capacities up to 900 g.p.m. against pressures up to 700 lbs. For electric and other type drives from 60 to 350 h.p.



GENERAL SERVICE

Peerless Type A pumps afford top-flight, continuous duty operation with capacities from 50 to 70,000 g.p.m. Heads: 15 to 300 ft. All types of drives: 1 to 1000 h.p. Sizes: 2" to 42" discharge. Split-case, single stage, double suction type.



PROCESS SERVICE

Peerless Type DS is the ideal pump for chemical, oil, soap and similar process services. Capacities: 10 to 1500 g.p.m. Heads: up to 231 feet. Handles a wide variety of corrosive or non-corrosive liquids at temperatures to 200° F.; single stage, single suction.

FIRE PROTECTION

Peerless Underwriters' Approved fire pumps are available for all fire protection services. Capacities: 500 to 2000 g.p.m. Pressures: to 150 lbs.; single and double stage types, for electric, engine, turbine drive or combinations.

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Factories: Los Angeles 31, Calif.; Quincy, Ill.; Indianapolis, Ind. *District Offices:* Chicago 40, 4554 North Broadway; Philadelphia Office: Suburban Square, Ardmore, Pa.; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, Calif.; Los Angeles 31, California

Manufacturers' Publications

Water Main Linings—(26-p. brochure) Provides numerous photographs and charts to illustrate centrifugal application of cement-mortar linings for water mains by Centriline process. It also includes information on water-main reconditioning, findings on effectiveness of cement linings, coefficients before and after centrilining, range of applicability, physical tests of cement-mortar linings, reclamation of abandoned mains, protection of new steel mains, and A.W.W.A. standard specifications.—*Centriline Corp.,* 140 *Cedar St., New York* 6, *N. Y.*

Marine Diesel Engines—(28-p. bulletin describes and illustrates how diesels are designed and built, with 48 photographs, 8 performance charts and 5 blueprints. Horsepower ratings and specifications are given for all engines, both supercharged and non-supercharged.—*Superior Engine Division, National Supply Co., Springfield, Ohio.*

Cranes, Hoists and Trolleys—(8-p. catalog) Describes and illustrates company's entire line of hand-powered and electric cranes, hoists and trolleys.—*Conco Engineering Works, Mendota, Ill.*

Highway Construction—(16-p. booklet) Shows diesel track-type tractors, equipped with bulldozers and scrapers; diesel wheel-type tractors; and diesel motor graders engaged in road work. It also shows diesel engine installations in draglines, shovels, compressors and crushing plants.—*Caterpillar Tractor Co., Peoria* 8, *Ill.*

Timber Connectors—(12-p. booklet) Illustrates and describes installation of split rings and shear plates for wide span roof trusses and other heavy structures, and toothed rings for light built-in structures where power is not available.—*Timber Engineering Co.,* 1319 18*th St., N. W., Washington* 6, *D. C.*

Rock Boring Machine—(8-p. booklet) Contains complete descriptions and illustrations of earth and rock boring machines in action, both horizontal and vertical types.—*Salem Tool Co., Salem, Ohio*

Fire-Resistant Canvas—(12-p. booklet) Describes Fire Chief treated canvas, including resistance to fire, water, weather and mildew, and shows typical

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MAINTAINS PERFECT BOND DURING SUB-ZERO TEMPERATURES

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HOT-POURED RUBBER SEAL

PARA-PLASTIC remains flexible all year 'round. Its elasticity is permanent in any temperature without breaking its bond with concrete.

PARA-PLASTIC maintains a positive and permanent seal in any temperature against the infiltration of water.

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ORIGINAL
ALL YEAR 'ROUND!

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PARA-PLASTIC is the ORIGINAL hot-poured top seal for concrete expansion joints.

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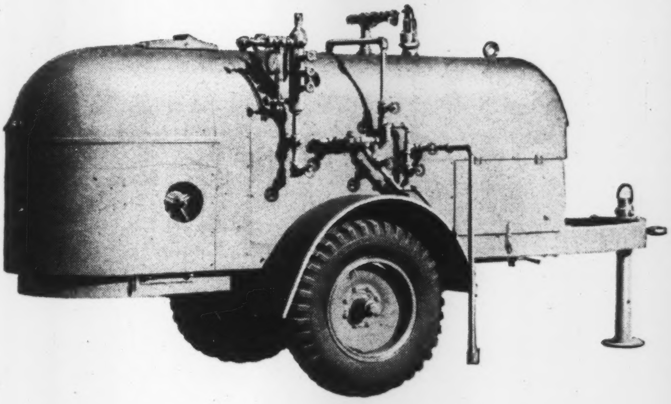

Cleaver-Brooks Mobile Tank-Car Heater — Not just a boiler on wheels, but a compact, rugged, highly efficient steam generator — built for a specific purpose. Available in two and three tank car heating capacities. Oil-fired, extra-high heat transfer design, dry-coil steam condensate return under pressure — no water or heat losses. Can also be profitably used for an all purpose unit for steam cleaning, thawing and heating.

THE tank car on the siding is the starting point for fast work on any oiling or bituminous surfacing job. The quicker you get the oil or asphalt up to application temperatures and flowing into the relay trucks or distributors — the faster your work crews can get going.

Cleaver-Brooks tank-car heaters are expressly designed to be shooting steam through tank car coils at 125 lbs. pressure in 20 minutes or less. And they can keep going full tilt all day with a very minimum of attention and work because a Cleaver-Brooks tank-car heater uses less fuel and water. Its extra high heat transfer design means fuel savings; its turbine type condensate return means less water . . . every drop of condensate goes back to the heater and under pressure. The capacity for long hours and tough jobs is built into every Cleaver-Brooks Unit. For detailed information write for bulletin RM-102.

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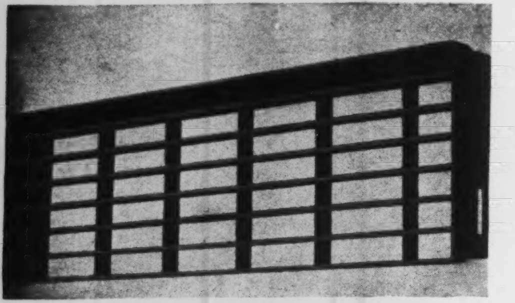
NOSING BAR HAS DUAL ADVANTAGES ON MITCO SHUR-SITE TREADS



Here's a patented, double-value feature of Hendrick Mitco Shur-Site Treads. The heavy, flanged nosing bar makes each step distinctly visible, for accident prevention, and it also provides additional strength at the point of heaviest loading.

Shur-Site treads have all the other Mitco advantages, including non-slipping, non-clogging surfaces.

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installations in different climates.—*Wm. E. Hooper & Sons Co., Junipe & Cherry Sts., Philadelphia, Pa.*

Air Conditioning Units—(12-p. catalog) Covers two complete lines o Latenaire and Sensaire air conditioning units, including remote and self-contained models of both floor and wall types, as well as duct-type coil. Complete specifications and engineering data are given.—*American Coils, Inc., 360 Thomas St., Newark 5, N. J.*

Shovel-Cranes—(12-p. catalog) Presents story of ¾-yd. LS-70 shovel-cranes.—*Link-Belt Speeder Corp., Cedar Rapids, Iowa*

Straight-Blade Bulldozers — (12-p. booklet) Records structural and operational features of Nos. 8S, 7S and 6S bulldozer units which are designed exclusively for use with Caterpillar diesel D8, D7 and D6 tractors. Blade, tilting brace and sheave construction are illustrated with cross-section views.—*Caterpillar Tractor Co., Peoria 8, Ill.*

Truck Bodies and Hoists—(6-p. folder) Describes and illustrates hydraulic hoists, vertical hand hoists and Type A and B bodies.—*Kewanee Mfg. Co., Kewanee, Ill.*

Car Shakeout—(12-p. booklet) Describes new unit for unloading hopper-bottom cars without manual labor. Reports from owners of this equipment are included.—*Robins Conveyors Division, Hewitt-Robins, Inc., 270 Passaic Ave., Passaic, N. J.*

Water Wells—(200-p. handbook) Contains charts, tables and other data pertinent to drilling, testing and operation of water wells. It is compiled and edited by Keith E. Anderson, geologist and engineer, Missouri Geological Survey and Water Resources. Book will be ready for distribution soon and will be sold at cost.—*Missouri Water Well Drillers Association, P. O. Box 250, Rolla, Mo.*

Heavy Operating Machinery—(12-p. bulletin) Presents illustrations and information on lock and dam machinery, gate and valve lifts, bridge operating equipment and other machines involving standard or special mechanical drive equipment built to specifications. —*Foote Bros. Gear & Machine Corp., 4545 S. Western Blvd., Chicago 9, Ill.*

Rear-Dump Truck — (6-p. folder) Describes Model TD rear-dump Euclid, which has payload capacity of 22 tons and is powered by 275-hp. diesel engine.—*Euclid Road Machinery Co., Cleveland 17, Ohio.*